Of this issue more than 4000 copies were printed

The Welding Engineer

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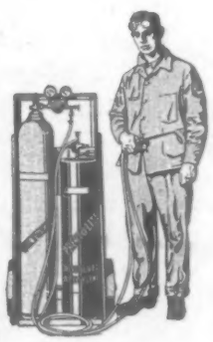
Oxy-Acetylene Welding and Cutting

This process has a field of its own in every shop and factory



No matter what other welding methods you now employ, and no matter how profitably, you also need the Prest-O-Lite Process. It handles several classes of work no other welding process can touch. Hence, it opens up a much wider field for the profitable use of welding.

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Prest-O-Lite PROCESS

*Alphabetical Index to Advertisers and Buyers' Index, Page 4.

The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

ACETYLENE GENERATORS
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
International Oxygen Co.
Metals Welding Plant
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

ALUMINUM FILLER RODS
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Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM FLUX
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Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ALUMINUM SOLDER
National Solder Co.
So. Luminum Mfg. & Eng. Co.

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

APRONS (Asbestos)
Welding Materials.

ASBESTOS GLOVES
Welding Materials.

ASBESTOS SHEET PAPER
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BLOW TORCHES (Acetylene)
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Indiana Oxygen Co.
Metals Welding Plant
The Alexander Milburn Co.
The Prest-O-Lite Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
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Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

BRASS SPELTER WIRE
Universal Oxygen Co.

BRAZING OUTFITS
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Superior Oxy-Acetylene Machine Co.

BRONZE FILLER RODS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

BUTT WELDERS (Electric Resistance)
Thomson Electric Welding Co.
Welding Materials.

CARBIDE (Calcium)
American Carbolite Sales Co.
Union Carbide Sales Co.
Canada Carbide Sales Co.

CARBON REMOVING TORCHES
American Oxygen Co.
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Equipment Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Metals Welding Plant
The Alexander Milburn Co.
Metals Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

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Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.
Welding Materials.
General Electric Co.

ELECTROLYTIC OXYGEN PLANTS
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
United States Welding Co.
The Prest-O-Lite Co.

FILLER RODS (Swedish Iron)
Apex Steel Corporation.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Tobin Bronze)
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Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FILLER RODS (Vanadium Steel)
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FLUE WELDERS (Electric Resistance)
Thomson Electric Welding Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

GASOLINE PREHEATING FURNACES
Buffalo Dental Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

GLOVES (Asbestos)
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Welding Materials.

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Bermo Welding Apparatus Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
F. A. Hardy & Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Julius King Optical Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co
Welding Materials.

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Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Universal Oxygen Co.

GAUGES (Pressure)
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Bermo Welding Apparatus Co.
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Davis-Bournonville Co.
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Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
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K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

HYDROGEN
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Alger Supply Co.
Goldschmidt Thermit Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.

NEEDLE VALVES
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

OIL BURNERS (Preheating)
Alger Supply Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co.

OXYGEN (Compressed in Cylinders)
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

PIPE WELDING
Goldschmitt Thermit Co.

PHOTOGRAPHS
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

PLASTIC (Fireproof)
Welding materials.

PRESSURE GAUGES
The Bastin & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
United States Welding Co.
Universal Oxygen Co.

RAILROADS—Special Service for
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REGULATING VALVES (Acetylene)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Hydrogen)
The Bastin-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

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Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

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Thomson Electric Welding Co.

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Thomson Electric Welding Co.

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The Thermalene Co.

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General Welding & Eq. Co.
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The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
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The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

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Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Plant
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Metals Welding Plant
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Welding)
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Henderson-Willis Welding & Cutting Co.
Metals Welding Plant
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United States Welding Co.
Universal Oxygen Co.

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The Bishop-Babcock-Becker Co.
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International Oxygen Co.
Universal Oxygen Co.

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Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.
Welding Materials.

WELDING (Oxygen for)
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

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Bermo Welding Apparatus Co.
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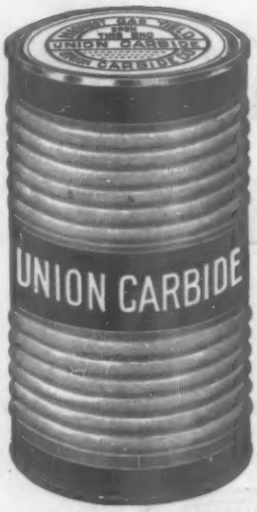

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"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

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ARKANSAS
Fort Smith—109-123 So. Ninth St.
CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—577 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—413 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—721-731 So. Washington St.
Marion—315 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.
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Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—921 Wabash Ave.
IOWA
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—925 Fourth St., P. O. Box 298.
KANSAS
Pittsburg—109 W. Third St.
Salina—154 So. 5th St.
Wichita—721 Beacon Building.
KENTUCKY
Louisville—126 E. Main St.
Middlesboro—
LOUISIANA
New Orleans—819-21 Julia St.
MAINE
Portland—202 Commercial St.
MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.
MICHIGAN
Detroit—Jefferson Ave. and Orleans St.
Grand Rapids—135 Ottawa Ave., N. Y.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
Saginaw—1902 N. Michigan Ave.
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MINNESOTA
Minneapolis—334 N. First St.
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MISSISSIPPI
Vicksburg—1312 Washington St.
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We own and operate one of the finest brass shops in America and are prepared to execute orders for special apparatus on contract, per sample. Send us your specifications.

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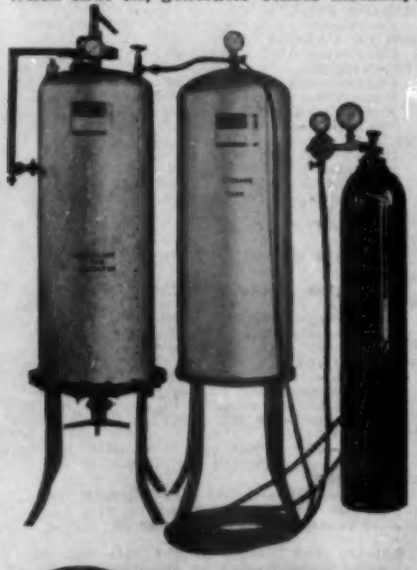

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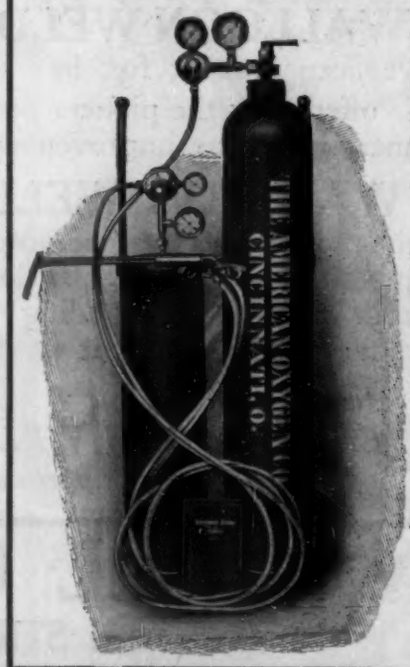
We are glad to recommend "Vulcan" welding and cutting apparatus to our customers. No better tools are made and when used in connection with "American" and "Watergas" oxygen, with high grade acetylene, we know our customer will get results.



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Milburn mixing principle produces best work with minimum gas, and no flash backs, burnt tips, or other annoyances.

Exceptionally durable construction of torches insures long, satisfactory service. Regulators dependable and free from valve, diaphragm and gauge troubles.

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is to broken equipment what a new point is to your pencil. Its use gets the other 95% value out of your equipment that has broken long before its mechanical life should have gone.

Reclaim the profits discarded in your scrap pile with our Oxweld outfit. A broken tooth on a gear is easily built up and refinished and the gear goes back to work for its full life, and so on throughout the whole list.

On your wrecking trains this outfit will prove of untold value. Tangled steel wreckage is quickly cut up; service is quickly resumed. The cost is tremendously reduced. The profit is the difference between scrap value and replacement cost, less the small cost of repairs.

Oxweld Railroad Service Co.

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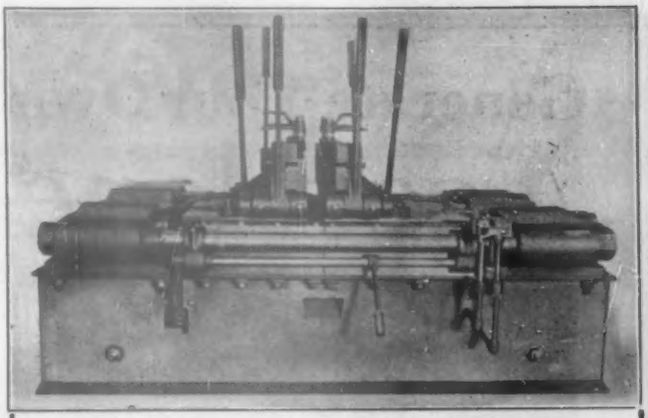

Butt Welders a specialty. 200 K. W. Welder, hydraulic pressure, clamps for stock up to 1 inch thick and 18 inches wide auto-truck rims, etc. 102 x 86 x 66 inches high, 12,700 lbs.

The "Thomson" Electric Welders

They are efficient and do not require an expert to operate. Operate the levers and the machine does the rest. No noise or confusion—no danger. In your plant you may have use for a "Thomson" Electric Welder. Why not prepare to reduce your manufacturing costs by studying the possibilities right now? Describe the shape, tell us the size of the smallest and largest piece, the maximum number of welds required per day, the cost of current per kw. hour; we will then tell you what it will cost you to electric-weld. If you haven't an alternating current, your local Lighting and Power Company has.

Weld Your High-Speed Steels

We Job Weld Also

Thomson Electric Welding Co.

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The Pioneer Manufacturers

Generate Your Own Acetylene

You can make your gas cheaper and have it when you want it.

METWELD

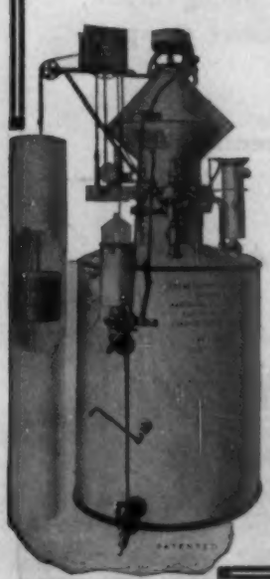
GENERATOR

will produce gas at a cost of less than a cent per cubic foot.

It can be operated by any workman and is equipped with locking devices which make it absolutely safe.

We have a plan by which you can pay for this generator out of the money you save with it.

Write for this plan and copy of our catalog. Tell us how many welders you are working.



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Welding Grate Bars in the Manufacture of Smelter Grates

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The K-G Apparatus is accepted by those who know as the best money can buy. It is built to stand up.

This is not merely a statement of our opinion, but is proven by their universal adoption and long continued use.

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SERVICE Will Help You

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OXY-ACETYLENE APPARATUS
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Both Portable and Stationary
Welding and cutting torches, with copper tips.
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Sheet metal and aluminum torches.
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For highest pressure up to 10,000 lbs. to the sq. inch.
TIGHT—FLEXIBLE—DURABLE
Safest, Reliable and most Economical hose for welding and all other purposes where plain rubber hose is used and is not satisfactory.
ATLANTIC METAL HOSE CO., INC.
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Use either electrode at will, all adjustments are automatically made by G-E Arc Welding Outfit

Welding Seams on Locomotive Firebox

Cuts Repair Cost—Saves Time

If chippers are busy elsewhere don't wait—let the G-E arc welder do its own chipping. Don't even take time to remove a flat wheel—the G-E arc welder will build it up while in place. You can control heat and building of metal, thus preventing distortion, uneven crystallization and cavities.

The G-E arc welder is used all over the world. It has made good in China; it is making emergency repairs for the Suez Canal and the rapid transit rolling stock of New York City is kept in shape by its help.

Our nearest local office will be pleased to give you additional information.

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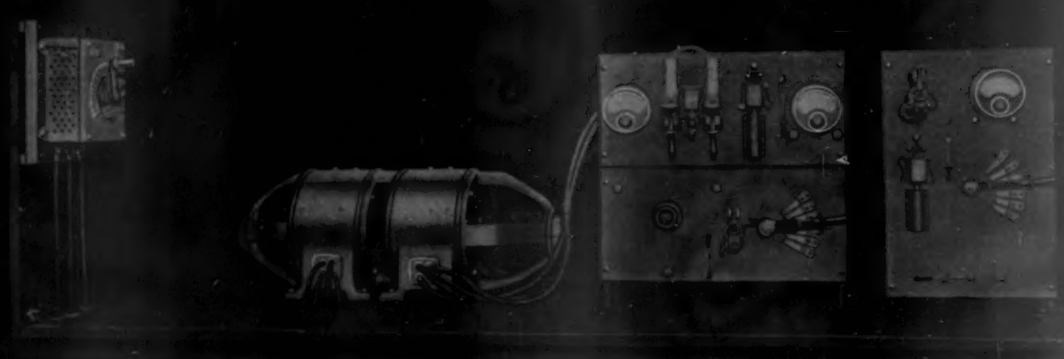

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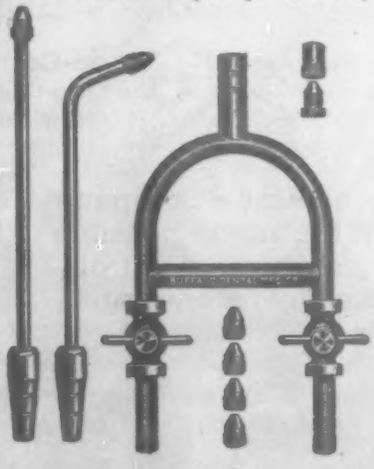
Please address request for information or prices to General Office, Duluth, Minn.

FOR LEAD BURNING

Our No. 28 Oxy-Hydrogen Lead Burner is most complete. Equipped with taps that are ground to a seat, making them easy to manipulate—safety gauzes in the throat of the yoke to prevent accident by a flashing back of flame—a series of jet tips with varying sized



orifices, and a wind shield adjustment to permit its use in draughty places. A straight and curved burner shaft that will meet every possible condition. Price, complete with 5 feet rubber connecting tubing, $7.00. Ask for catalog "B. X.," illustrating and describing this and all our chemical laboratory apparatus.

Buffalo Dental Mfg. Company
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WELDERS' GOGGLE No. 3

White non-rusting metal, folding screens, all metal parts covered to prevent the frame from getting heated and burning the skin. Fastened on by an elastic headband.

No. 3. Mounted with first quality, gray green glass .....$1.50 each
Mounted with the new American Noviweld glass .....$2.00 each
Quantity prices upon application

After experimenting for two years we have succeeded in producing a glass especially for Welders, equal, if not superior, to the German make. The Gray green glass used in our goggles is an American product.

The above goggles furnished with light smoked, blue, amber or clear white glasses

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Manufacturer, Importer and Wholesale Dealer in
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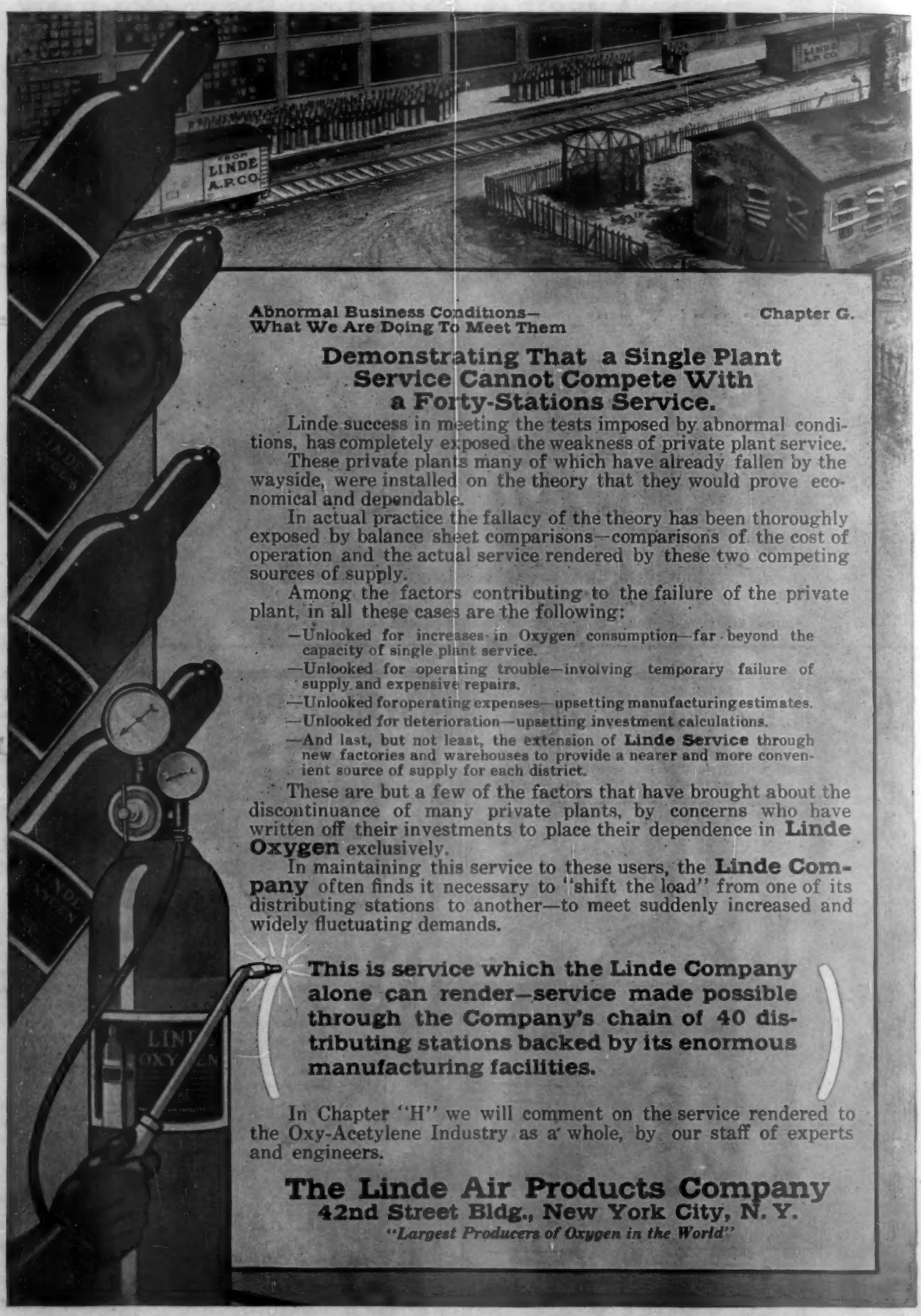


Abnormal Business Conditions—
What We Are Doing To Meet Them **Chapter G.**

Demonstrating That a Single Plant Service Cannot Compete With a Forty-Stations Service.

Linde success in meeting the tests imposed by abnormal conditions, has completely exposed the weakness of private plant service.

These private plants many of which have already fallen by the wayside, were installed on the theory that they would prove economical and dependable.

In actual practice the fallacy of the theory has been thoroughly exposed by balance sheet comparisons—comparisons of the cost of operation and the actual service rendered by these two competing sources of supply.

Among the factors contributing to the failure of the private plant, in all these cases are the following:

—Unlooked for increases in Oxygen consumption—far beyond the capacity of single plant service.

—Unlooked for operating trouble—involving temporary failure of supply and expensive repairs.

—Unlooked for operating expenses—upsetting manufacturing estimates.

—Unlooked for deterioration—upsetting investment calculations.

—And last, but not least, the extension of **Linde Service** through new factories and warehouses to provide a nearer and more convenient source of supply for each district.

These are but a few of the factors that have brought about the discontinuance of many private plants, by concerns who have written off their investments to place their dependence in **Linde Oxygen** exclusively.

In maintaining this service to these users, the **Linde Company** often finds it necessary to "shift the load" from one of its distributing stations to another—to meet suddenly increased and widely fluctuating demands.

This is service which the Linde Company alone can render—service made possible through the Company's chain of 40 distributing stations backed by its enormous manufacturing facilities.

In Chapter "H" we will comment on the service rendered to the Oxy-Acetylene Industry as a whole, by our staff of experts and engineers.

The Linde Air Products Company
42nd Street Bldg., New York City, N. Y.
"Largest Producers of Oxygen in the World"

Reminiscences of a Welder

Each With a Moral

I—The Vanderbilt Cup Winner's Leaky Cylinders

To those of us who are interested in automobiles and even if we can't all afford to ride in them, surely we are interested in them, the name of Harry Grant is well known. Driver of the famous Alco, winner of the Vanderbilt cup for two successive years, pounding over the roads of Long Island at an average speed of 75 miles per hour, Grant earned his reputation as the best "money driver" in the game. Out of his racing togs he looked like a prosperous well fed business man, chunky and inclined to stoutness, conservative in appearance and talk—the last man who looked or acted as if he would take the terrible chances of automobile racing. The game got him last year at Sheepshead, his death resulting from serious burns when his car caught fire.

Grant made his home in the town in which I owned a welding shop and through mutual friends in the automobile business we became acquainted.

Following his first victory (I believe it was 1910) he came to town to spend the winter, bringing his Alco with him and shortly after his arrival he found that the rear pair of cylinders had developed a crack in the water jacket and were leaking badly. After vainly trying all cement preparations, he came to me. Could those cylinders be welded without affecting the bore or the valve chamber? (The crack ran dangerously near the inlet valve.) Now. if that automobile had been an ordinary car, I would have unqualifiedly answered yes, but because it was the winner of the Vanderbilt Cup, I hedged. Couldn't he fix it by rusting? No, he had tried everything. Then came what seemed to me to be a happy thought. Why not get a new pair of cylinders from the factory? Surely it was not expense that bothered him. Wherein I showed my ignorance of a racing car. Did I not know that the bore of those cylinders was as highly polished as glass and that that smoothness came only by driving slowly and carefully for hundreds and even thousands of miles; by constant inspection and fitting of the pistons?

The value of a new pair of cylinders was I believe about $85, but the value of that particular pair to Grant could not be reckoned in dollars. Here was the car which he had petted and cuddled, which had carried him to fame and earned big money prizes and just as it stood it represented perfection. A change in cylinders meant weeks and months of toil and a destruction, temporarily at least, of that perfect synchronism of the motor. Perhaps he had a hunch as well, that as it stood it would carry him to another victory and that a change meant a change in luck. So welding was decided upon.

When the great racer drove into the shop the morning of the chosen day, all work ceased and the men thronged around the car. Promises for other work were wholly neglected—not a man would work while the cylinders were being taken off and stripped, a fire brick furnace made ready and the cylinders put in ready to preheat. We employed gas flame, so designed that the heat was evenly distributed and with but little air in the flame in order to avoid a too concentrated heat. Grant elected me as the welder—no one else should touch them—an honor I tried to sidestep and give to one of the men, for a reason which is obvious; I wanted someone to blame in the event of failure.

With Grant at my elbow the gas heating flames were lighted and when those flames lapped that beloved pair of cylinders, the famous driver became as nervous as the proverbial witch is supposed to be. Before the oil had hardly begun to burn off he was begging me to start welding. Long before the cylinders had reached a heat sufficient to penetrate to the bore and while the hand could still be laid upon them, he was a veritable wild man. We would surely spoil them. Finally he could stand it no longer and forbade their further heating, insisting that the weld be made at once. Trying to explain to him the principles of expansion and contraction and telling him that the cylinders must be heated evenly and to a dull red before welding had about as much effect on him as would a pacific talk with a hysterical woman. So at his orders, the weld was made, the gas flames allowed to play on the cylinders a few minutes and then short fiber asbestos thrown in the furnace to completely cover them until cool. Then we all listened for about half an hour, but no noise emanating from the furnace, I told him to come back the next day and we'd see how they looked, telling him that I thought they would surely be cracked open.

But the next morning showed the cylinders whole. To make certain I gave them a water pressure test and then had the weld ground down. Every man in the shop was happy—the boss was some welder—but the boss was not so happy; he had a feeling that all was not as it should be; yet he could not explain why.

Grant arrived and the cylinders were again connected for a water pressure test, they were carefully examined while under pressure and I had to listen to much talk about how little I knew about heating. Why, there wasn't any need of even taking the cylinders off—this preheating stuff was all bosh and if I had had my way the cylinders would have been ruined; and more of the same line for a half hour or so. All this time the cylinders were on the floor, they had been welded for 24 hours, had been tested twice, when BANG! Close to the weld was a yawning crack considerably longer and lots wider than the original break had been. Wild eyed, Grant looked at it, when BANG! Another crack on the other end of the cylinder. Before anyone in the shop realized what he was doing, Grant had seized a sledge hammer and brought it down with all the force of his powerful arms directly on the top of the casting and the famous Alco cylinders were no more; they were simply small pieces of cast iron.

I realize now that the second attempt would probably have been successful, but even if I had realized it then, there wouldn't have been any second time. The internal stress in that pair of cylinders must have been terrific, judging by the noise they made when they cracked open, but Grant's quick action with the sledge deprived us of a second chance or a proper autopsy.

What moral can we draw from this little event? It might be said that too many cooks spoil the broth with some degree of truth or someone might say that it doesn't do to have the owner of the article around the welding shop while his job is being done; and I would heartily concur, but the one I like the best is considerably broader. It's been my experience that it needs considerable thought and study. It doesn't look very important, yet the more

you say it over to yourself, the more you'll realize its tremendous importance and guard against failures. Here it is:

MORAL—The Law of Expansion and Contraction Cannot Be Violated.

Next Month—The Rear Housing on that Darracq Car.

OXY-ACETYLENE WELDING OF COPPER. THEORY AND PRACTICE.

By J. B. Diehl.

The welding of metals depends on two things, viz.: the Flow and Cohesion.

Flow is almost synonymous with malleability, the difference being a matter of time.

Many substances which flow slowly, will not withstand the shock of a hammer.

Most metals flow at all temperatures from normal to the melting point, but they are the most easily weldable within the range of the greatest plasticity.

Cohesion governs welding to the extent that no matter how fluid a metal may be, if there is no cohesion of the surfaces to be joined, a weld will not take place. Aluminum is a very good example of this. The metal is quite malleable at most temperatures, but a microscopic film of oxide will tend to prevent cohesion. By using a suitable flux when welding, this oxide can be made to disassociate from the metal, allowing perfect cohesion.

In the welding of copper, the flow and cohesion greatly favor the welder; although there are other obstacles to be taken care of which we will take up later on.

Copper is one of the oldest, if not the very oldest, of metals known today. Its symbol Cu. is obtained from the Latin name Cuprum. Has a characteristic reddish color, melts at 1949 degrees Fahrenheit, stands next to silver as a conductor of electricity and heat and is surpassed in ductility and malleability only by gold and silver.

The tensile strength, which is about 33,000 pounds per square inch at ordinary temperatures, decreases very quickly under the action of heat, falling to 14,000 pounds per square inch at 935 degrees Fahrenheit.

Until recent years, it was not considered advisable to make oxy-acetylene welds in copper, riveting, soldering or brazing being preferred, as either of these could be accomplished below the temperature of crystallization.

Rolled copper has a specific gravity of 8.9 and is distinctly heavier than iron or steel. The specific heat of copper is 0.951, while that of steel is .1165 soft and .1175 hard. Therefore, it will require 20 per cent less heat to raise the temperature of copper than it will for steel. While it is not only easier to heat copper up in welding, owing to its melting point being 1949 degrees Fahrenheit to that of 2500 for steel, we encounter a new factor of large proportions in the form of the high heat conductivity of copper.

Taking silver as the highest thermal conductor at 100 points and placing copper and steel in their order at 73.6 and 11.6 per cent respectively, we find that in copper the section adjoining the weld will distribute the heat just about six times as fast as is possible with steel, thereby retarding the speed in raising the temperature.

In welding steel, owing to its low heat conductivity, we are able to make a melt involving a very small heated section on either side, whereas, in copper welding, the rapid conduction of heat tends to form a comparatively wide zone of highly heated metal. Still another fact worth consideration is, that although the temperature of the heated zones are lower in copper than in steel, when we take into consideration the melting points of these metals we find that in copper the temperature of these zones is relatively high.

The coefficient of expansion for copper is much higher than for steel, being .00000955, against .00000599, subsequently the contraction will be more rapid as the metal cools, although the total amount of contraction will be less than for steel owing to the lower fusing temperature. Obviously, this is not of so much importance as the rate of contraction which must be watched carefully in copper welding. Upon bringing the joint to be welded to the melting point, we find that we have created a wide zone of highly heated metal as explained above, which gives us perhaps the greatest difficulty to contend with. Copper in a melted or highly heated state readily absorbs oxygen from the air and forms with it red oxide of copper which alloys with the metal.

This state can readily be detected by the sparks flying from the molten metal and causing blisters as the metal solidifies.

The metal will then appear a brownish red and much darker than pure copper.

This oxide undoubtly destroys the coherence of the copper crystals by becoming imbedded between them, materially reducing the strength of the joint.

As stated previously, the tensile strength of copper decreases very rapidly under heat, so that just below its fusing temperature it passes into a condition that certain mechanical operations will reduce it into powder. Therefore, tensile strains are to be avoided while the copper is passing through the critical temperature state, otherwise cracks may reasonably be expected.

To protect the heated regions from oxidation through exposure to the air, it is advisable to provide some agent in the form of a flux coating, or some material supplied through the welding rod to decrease the power of the oxygen of the air to oxidize.

We are again awakened to another phenomenon in which the molten metal will readily absorb other gases, especially the hydrogen, which may be formed from an incorrect welding flame, and is given off in the form of a copper "rain," as this peculiar action is known. If the copper hardens on the surface first, the weld will be porous, owing to a percentage of the oxygen remaining in the metal.

It is essential that the acetylene used for copper welding be pure, otherwise the impurities would be absorbed by the metal. Numerous writers claim that to weld copper successfully an excess of acetylene should be used, but after conducting numerous tests the writer has obtained best results by using a carefully regulated neutral flame with a torch that supplied the gases in the correct proportions.

As the molten metal will readily absorb hydrogen and carbon monoxide, care must be taken not to use an excess of oxygen, because this is extremely harmful as explained above, and for the following reasons.

If too large a proportion of oxygen is supplied, the excess oxygen must pass off in the envelope, owing to all the carbon having been used by the proper proportion of oxygen. Two parts of oxygen uniting with one part of acetylene will yield hydrogen carbon monoxide and a surplus of free oxygen. The small white cone should never be forced into the metal, as this contains oxygen, carbon and hydrogen in the uncombined state, the latter two being the products of the disintegration of the fuel gas acetylene.

As the products of combustion at the end of this cone are hydrogen and carbon monoxide, it is advisable to hold the torch in such a manner that this cone will be some distance from the metal, depending upon the size of the flame.

This distance will have to be determined by the operator, bearing in mind that one of the final products of the combustion of the gases in the oxy-acetylene flame is carbon dioxide and is capable of freeing copper of absorbed hydrogen.

In other words, the oxygen needed to burn the carbon

monoxide to carbon dioxide is taken from the air, thereby fleecing the atmosphere of some of its ability to oxidize.

The welding of copper requires a large low temperature flame, which can be obtained by holding the torch the required distance from the metal, and requires more skill than the welding of iron.

The iron welder will find it rather difficult to do satisfactory copper welding at the offset, inasmuch as it is a strange metal which he does not understand how to handle.

Copper welding is as simple as steel welding when the operator becomes acquainted with it; in fact, it is a very pleasant metal to weld; one in which the operator can take pride in doing a good job.

Copper flows like steel and can be finished with the rippled effect if desired.

The hand movement should be steady, and rapid if necessary, and the eye quick to detect the fusion point.

The tip is held vertically for copper welding, not obliquely, as with other metals. The idea being to surround the "melt" with the envelope of the flame to debar the oxidizing element of the atmosphere oxygen. One source of trouble in welding copper that is experienced by numerous operators, is the fact that they try to rush the work. Successful copper welding is obtained only after considerable "trying."

Unless the parts are light, it is advisable to preheat them on account of the high heat conductivity of the metal, and it is only after failing several times that the beginner will realize the high temperature of heat which must be obtained before the welding operation is started. When this point is reached, and the metal prepared either with flux or a special welding rod, the welding is easy, often demanding that the operator quicken his movements to keep up with the flow of the metal.

On any work heavier than light sheets the edges should always be grooved to the bottom, or if prepared from both sides the grooves should be into the center, as this is one of the requirements for success.

The operator should not try to dig down in the metal, or he will be troubled with a porous weld upon completion. When the metal arrives at the fusing temperature, the melt rod is applied and the metal will flow together like steel. It is also inadvisable to linger over the metal, as this is another source of blowholes, inasmuch as the paste that was applied to that section is used up, leaving it open to oxidation, or if a material is supplied through the welding rod the allotment may become exhausted through the delay.

Therefore, it is always advisable to repaste a section that requires going over.

Owing to the rapid distribution of the heat, it is advisable to lay sheets of asbestos on either side of the joint, both underneath and on top, to hold the heat as close to the weld as is possible, and to exclude the air. In doing this, it is advisable to heat the sheets with the torch first, to drive out any moisture they may contain. The feeder wire may be more advantageously applied if it is somewhat smaller in diameter than the thickness of the metal being welded, and should be allowed to touch the bluish molten stream melting away regularly.

To increase the strength and elasticity of copper, it should be cooled off after welding and filed or ground, after which it is worked with a small hammer.

If by means of the welding powder we desire to make the copper especially fluid and bind the oxygen, the powder should contain phosphorous salts, which, however, must be added to the powder only in certain quantities, so that the phosphorous will not remain in the metal and make it brittle.

Small traces of phosphorous are really not harmful to the copper.

However, this article is not intended to influence the welder to try to compound his own flux, as they are generally unsatisfactory. Often, owing to some material being added whose specific gravity is greater than that of the molten metal, the result being, instead of it rising to the top of the metal it will sink and remain in the weld, this being only one of the numerous objections.

Fluxes to meet the requirements can be obtained from reliable manufacturers cheaper and better than the welder could make them, as they are compounded from special analysis.

SOME OF THE USES OF THE OXY-ACETYLENE BLOWPIPE IN THE RAILROAD SHOP.

By B. Kopferschmidt.

In no other country are the railroads as a whole maintained on a higher scale of efficiency and considering the keen competition and regulated rates, this efficiency is absolutely necessary. These restrictions and the present competition calls for the installation of many expensive devices to improve the mode of manufacture or to reduce the cost of maintenance. If one railroad adopts them, its competitors do likewise. Let the railroad manager cling to antiquated and obsolete methods and he is soon hopelessly outdistanced by his more aggressive and modern competitor.

One of the most modern and efficient devices for the railroad shop, is the oxy-acetylene cutting and welding apparatus.

We have mentioned in the past a great many operations where expensive articles can be reclaimed from the scrap pile and from among many other possibilities, the writer will deal at present, with reclaiming defected or worn out manganese steel, railroad frogs and diamond crossings.

Manganese steel is an alloy of iron and manganese, containing a considerable proportion of carbon. If there is a very small portion of manganese the effect is slight. As the proportion of manganese rises above 2.5 per cent the strength and ductility diminish, while the hardness increases.

This hardening effect is a maximum with about 6 per cent manganese. Above this the strength and ductility both increase and at 14 per cent of manganese the metal is so hard that it is very difficult to cut with steel tools. Its toughness increases by quenching from a yellow heat. It has a remarkable combination of great hardness, which cannot be lessened by annealing, great tensile strength, toughness and ductility. The fact that it cannot be machined, on account of its hardness, limits its usefulness. It is used principally for railroad frogs, diamond crossings, car-wheels, dies and crusher-jaws.

Manganese steel can be forged and welded only with the oxy-acetylene blowpipe.

The principal defects of railroad frogs and diamond crossings that are practical for repairs, are the ones that are worn out on the face. In using the proper welding rod and cleaning flux, together with reflection, attention and a little practice, the welding presents no special difficulty.

The choice of a good welding rod is very important. Until the present time the writer could not obtain in the market a suitable welding rod to equalize with the rest of the metal and to leave the original hard surface. However, in a railroad shop there are always a few frogs, scraped and beyond repairs. With the aid of a cutting blowpipe and the smallest tip, one can cut off an old frog into narrow strips, followed by grinding off the burnt edges, and obtain an excellent supply of manganese steel welding rods.

It is also necessary to use a cleaning flux. The same flux that is used for cast iron, may be used in welding manganese steel.

Method of Welding.

The defected part where new metal has to be built should be cleaned with a hand grinder until the metal becomes

bright. The blowpipe or welding head is selected one size larger, with an oxygen working pressure of 35 lbs. (low pressure system) and 22 oxygen working pressure (high pressure system). The blowpipe is held a little inclined and moved in half circles about ¼ inch diameter, regulating the rapidity of the movement according to the melting and the bath of liquid metal obtained. Then build up enough metal until the original height is obtained. Then advance the same way the whole width of the rail. Considering that the welded portion is at a bright cherry red, the metal should be hammered down to a finished size, using in the course of hammering a gauge or straight-edge to insure a level face on the rail of the frog or crossing.

Then the operator may proceed further the same way until finished. The necessity of hammering in the course of welding to bring the surface of the weld level to a finished size, is because the surplus metal cannot be machined or chipped, but it could be ground. The grinding takes too much time, thus the hammering proved to be the best method for finishing the welds on manganese steel.

Another good feature is that the welding operation on frogs or diamond crossings, could be performed on the road bed or in the shop table.

THE PROCESS OF ELECTRIC ARC WELDING.

The rapid growth of electric arc welding is one of the marked mechanical features of the present decade. Perhaps its most serviceable field is in its use in railroad repair shops. In the welding of flues, in fire-box and frame repairs, in the repairing of engine and truck frames, corroded mud rings, in the upbuilding of flat spots in driving wheels, and the welding of driving wheel spokes as well as the welding of cracks in fire-box sheets and bridges in flue sheets, it is daily coming into more general and extended use, and the recent improvements made in the means and methods of its appliance are such that it has now reached a degree of adaptability that it has become an indispensable adjunct in general railroad repair work. Already nearly all of the larger locomotive repairs shops, and many car shops are fully equipped with arc welding appliances, and in nearly every instance the process is meeting with warm approval.

Doubtless the general depression occurring in railroad work in recent years has to a considerable extent hindered the progress of its adoption, but now that vastly improved conditions are upon us the growth of this industry is becoming more rapid. Another cause of the apparent degree of slowness has been the fact that in many instances the workmen were not sufficiently instructed in the details of the work. This drawback, however, bids fair to be remedied, and already special instructors are coming to be more readily looked upon as essential to the introduction of the appliance. Even schools are being established which, with some necessary federal or state regulation, are sure to be productive of furnishing a higher degree of skill among those seeking to obtain full knowledge in this new sphere of industrial activity.

Electric or incandescent welding, or, as it is generally called, butt and spot welding, consists of two parts of metal being jointed in a solid mass when placed together and by means of the necessary equipment a heavy current of electricity is caused to pass from one piece of the metal to the other, thereby heating both ends of the metal to the fusing point when the two parts are pressed together and the weld is made. Welding without pressure is also accomplished by the fusing of the two metals by simply causing them to meet and unite in cooling. Generally speaking, there are two classes of electric arc welding—the carbon electrode process in which the electric arc is drawn between the metals that are to be welded and a carbon electrode, and the metal electrode process. In the latter process the electric arc is drawn between the metal to be welded and a metal electrode.

The requirements are an adaptable source of electric direct current supply with a readily adjustable control furnished with means for holding the electrode so that it can be completely controlled by the operator. A protective covering is also necessary for the operator, also suitable filling material, which in the early days of electric welding, was usually of the same metal as that of the metal being operated upon, but recent extensive experiments have developed alloys that are not adversely affected by the intense heat of the arc. This specially alloyed steel is in the form of an electrode and is composed of a homogenous alloy combined with such excess of manganese as will be transferred across the welding arc and be left in the welded joint to add substantially to its toughness.

There has also recently come into use a manganese copper alloy welding metal as an electrode forming an arc, which is composed of iron homogenously combined with such an excess of manganese and copper over the amount burned out in the arc as will retain in the welded joint a substantially additional degree of toughness and ductility due to said excess. In general practice these filling pieces of metal are fed into the welder and melted into place, mixing with the pieces to be welded similar to the fusion of solder by the application of a blow torch.

The most satisfactory electric arc welding is done by direct current only. In the use of the alternating current for arc welding the arc is very unsteady, and also noisy and difficult to handle. Not only so, but the arc has a tendency to become extinguished as the current passes through the zero point. The electric power necessary is what is known as a low voltage application, and although direct currents of 110,220 or even 550 volts may be used in welding, this practice is very wasteful of energy, and while it may be used in emergencies or when power can be secured cheaply, better results are obtained with 75 volt circuits, and recent improvements have demonstrated the fact that volts below 50 and even as low as 35 are already successfully in operation. Appliances furnished with perfectly controlling devices with as low voltage as the latter figures referred to are already in service, and bid fair to come rapidly into popular favor.

The most convenient and economical method of welding is to use a motor generator set, the motor being constructed suitable for operation in the existing circuit, and applied to drive a low voltage generator. Either shunt or compound wound may be used. The former is adapted for one arc only, the latter is preferable if several arcs are intended to be supplied from the same unit. The power of the motor generator set should be adapted to the class of welding to be done and the number of arcs to be expected working coincidentally. The temperature rating is not the only consideration, as the service is generally of an intermittent kind, although when the arc is used in cutting, the service may be nearly continuous when due allowance must be made for the necessities of the conditions.

When compound wound, commutating poles should be provided on account of the heavy overloads expected in the continued and heavier welding work. What is known as flat compounding may be sufficient, while again it may be necessary to over compound 3 or 4 per cent of full load. This is especially the case when an induction motor is used, on account of the lessened speed when the heavier load comes on the motor. Recent improvements in the generating equipment are such that when commutating poles are used, a simple and perfect control system has been devised that meets every emergency.—*Railway and Locomotive Engineering.*

Railway Electrical Engineers Discuss Welding

Ninth Annual Convention Held at Chicago, October 31st, Hear Report on Electric Welding

Report of Sub-Committee "B" On Electric Welding.

In submitting the following report your committee has made an attempt to outline the elementary principles of electric arc welding practice. The application of the process in railroad shops is comparatively new, and it is possible that within a very short time the practices here recommended will become obsolete due to the rapid progress which is being made in the art of welding. The lack of authoritative literature on the subject, together with the great rapidity of the introduction of the process, has left each shop to proceed on its own resources and to solve the problems of welding through the ingenuity of the shop organization. The purpose of this report is to summarize, so far as possible, the information available on the installation and use of electric arc welding equipment in railroad shops.

Electric arc welding is a particular kind of autogenous welding. Autogenous welding is the kind of welding which is accomplished with heat, but without the use of pressure. Forge welding, butt and spot welding are welding processes in which both heat and mechanical pressure are used to produce cohesion of the molecules of the pieces being welded at the point at which they are to be joined. The difference between these two kinds of welding is entirely due to the difference in the intensity of the heat used. At the present time there are three methods in use of producing a heat of such intensity that metals can be welded without the use of mechanical pressure—the thermite reaction, the oxy-acteylene flame, the electric arc.

The Electric Arc.

An electric arc is formed when a current of electricity passes from one conductor to another conductor through an incandescent vapor. The conductor from which the current passes into the incandescent vapor is called the positive electrode or anode, the conductor to which the current passes from the incandescent vapor is called the negative electrode or cathode. It is estimated that approximately 75 per cent of the resistance offered to the passage of the current of electricity from anode to cathode occurs at the anode. The remaining 25 per cent of the resistance is in the vapor and in the cathode. It is generally believed that more resistance is offered by the cathode than in the vapor of the arc in short arcs such as are used in the arc welding process. Since the amount of heat in any part of the arc or electrodes is proportioned to the amount of resistance offered by that part of the arc to the passage of the electric current, it is evident that the visible arc or flame liberates a comparatively small percentage of the total heat of the arc. The largest part of the heat is liberated at the positive electrode.

Polarity for Welding.

Owing to the fact that the heat of the arc is produced in greater quantity at the positive electrode, in electric arc welding practice it is necessary to consider the matter of popularity.

In metal electrode welding, the mass of the welding wire which is being melted is usually less than the mass of the piece to which the metal is being added so that the amount of heat lost by conduction is greatest on the piece to which the metal is being added. For this reason, the piece of greater mass is made the positive electrode. In certain cases, such as the welding of very thin sheet metal, the wire being melted is made the positive electrode in order to reduce the tendency of the arc to burn through the sheet metal.

When the slag coated electrode is used, the wire is usually made the positive electrode. In this case, the arc operates under a slag so that a considerable percentage of the heat otherwise radiated is retained in the vicinity of the arc. This conservation of the heat on the heavier piece permits the higher rate of melting of the metal being added.

It is necessary to use the carbon electrode as the cathode in carbon electrode welding. The current of electricity must pass from the metal to the carbon, otherwise the carbon will be carried into the metal being welded causing hardness.

Amount of Heat Used in Electric Arc Welding

The electric arc transforms electrical energy into heat. The heat is intense because a comparatively large amount of energy is transformed into heat in a small area. One kilowatt hour of electrical energy is equivalent to 3,413 B. t. u. of heat. Thus an arc in which the current is 150 amperes and the voltage between electrodes is 20 volts will transform three kilowatts of electrical energy into 10,239 B. t. u. in one hour of continuous operation. Similarly, one cubic foot of acetylene gas burned in oxygen will produce 1,555 B. t. u. of heat. Thus the three kilowatt hours of electrical energy will produce the same amount of heat as may be produced by approximately 6.6 cubic feet of acetylene burned in 7.5 cubic feet of oxygen.

The amount of heat which can be used in the arc welding process depends largely on the size of the wire electrode being used. The kind of wire being used and the character of the piece being welded also affect this factor. The following table shows the limits indicated by present practice:

Kind of Electrode	Size.	Current.	Voltage.	Work.
Mild Steel	1/8 in.	60-90	14-16	2 in. flues
Mild Steel	5/32 in.	110-140	16-20	5 in. flues filling
Mild Steel	7/32 in.	150-180	18-25	filling
Carbon	3/4 in.	250-350	35-50	cutting welding
Carbon	1 in.	350-500	35-50	cutting welding

Elementary Metallurgy.

The electric arc welding process (metal electrode) is, reduced to its simplest terms, simply a means of melting steel wire and allowing it to flow while molten on to another piece of steel which has been melted over a local area. There are three important changes which occur in the metal during the process.

1. The effect of mechanical treatment is entirely eliminated over the area heated to a plastic or molten state. The metal thus affected becomes cast steel.

2. Unless the molten metal is protected by a slag covering, it is oxidized to a certain extent by the oxygen present in the atmosphere. This oxidation tends to make the metal cold short.

3. A large percentage of the impurities (carbon, manganese, nickel, vanadium, chromium, etc.), which may be present in the steel effected by the welding process before

the operation, is vaporized or oxidized and has disappeared after the operation.

The net result is that in bare wire welding, the metal obtained in the weld may be as high in tensile strength as the metal in the original piece being welded. It will be rather low in ductility, but will be soft if the metal before the operation was not over .35 per cent in carbon content.

No method has been demonstrated up to the present time of giving the cast steel in the weld the same characteristics to the same degree as those found in flange steel. The same tensile strength can be obtained and equal softness; but with the present development of the art of welding with the electric arc, equal ductility has not been produced. The cast steel in the weld may have practically the same characteristics as the cast steel used in locomotive construction so far as tensile strength, ductility and softness are concerned.

In spite of the comparatively low degree of ductility of the metal obtained in the weld, the process is entirely practical as a means of welding both cast steel and boiler plate owing to the fact that the welded area may be reinforced where great resistance to fracture must be produced. The net result of this practice is to stiffen the welded section to such an extent that under severe stress the original and unwelded section will fail before the metal in the weld is strained to the point of rupture.

Application in Railroad Shops.

The simplest application of electric arc welding in the raiload shop is the "building up" operation. Practically every steel casting on the locomotive is subject to wear at several points. Wearing surfaces are rapidly worn down and bolt holes wear large.

The metal electrode process should be used for these building up operations for the following reasons:

1. Locomotive steel castings welded with the carbon arc should be annealed before being put in service. The locomotive shop is not equipped to anneal castings.

2. Metal may be more accurately placed with the metal electrode process than with the carbon electrode process. Time saved in the welding operation using the carbon arc is more than lost in the machining operations.

3. Less skill is required to operate the metal arc than the carbon arc for building up operations.

4. There is no possibility of hard spots when the metal electrode process is used for the operation.

TABLE I.

STATEMENT OF WORK PERFORMED WITH ELECTRIC WELDER AT LOCOMOTIVE SHOPS.

1916	No. of engines	No. of flues welded	Actual time welding, hr. and min.	Labor	Material	Current	Total cost, actual welding	Time preparing for welding, hr. and min.	Cost preparing for welding	Total cost to engines	Average cost per engine
Total for 2-in. flues	247	42,640	2,811′ 15″	$990.77	$181.09	$843.72	$2,015.58	222′ 45″	$80.39	$2,093.97	$8.48
Total for 5-in. flues	196	5,034	1,473′ 45″	520.01	85.47	442.16	1,047.64	24′ 00″	10.08	1,056.12	5.39
Total for smoke consumer tubes	244	1,946	122′ 00″	42.85	9.76	36.60	89.21	———	———	89.21	.37

MISCELLANEOUS JOBS.

1916	No. of operations	Labor	Material	Current	Total cost	Other method	Saving	Saving per operation
January	461	$183.07	$47.88	$155.70	$386.65	$1,176.58	$ 789.93	$1.71
February	433	218.08	59.89	187.70	465.67	1,558.56	1,092.89	2.52
March	584	253.37	64.57	199.13	517.07	1,871.44	1,354.37	2.32
April	325	172.92	42.62	134.20	349.74	1,232.65	882.91	2.72
May	487	223.22	60.62	175.52	464.36	1,839.54	1,375.18	2.82
June	579	210.09	54.94	175.52	440.55	1,726.10	1,285.55	2.22
July	523	165.97	41.12	135.62	342.71	1,501.33	1,158.62	2.22
Totals	3,392	$1,431.72	$371.64	$1,163.39	$2,966.75	$10,906.20	$7,939.45	$2.34

TABLE II.

MISCELLANEOUS ELECTRIC WELDING—LOCOMOTIVE SHOP—ONE MONTH.

Description	No. of operations	Labor	Material	Current	Total cost	Other method	Saving
Bumper Beam	1	$1.41	$0.33	$1.35	$3.09	$5.00	$1.91
Brake Shoe heads	102	11.79	2.48	9.55	23.82	80.58	56.76
Brake Hanger Bracket	1	.33	.02	.08	.43	1.25	.82
Crossheads—Piston	17	12.96	3.29	10.53	26.78	133.06	106.28
Crosshead—Valve	22	2.39	.55	1.95	4.89	13.93	9.09
Crosshead Pins	3	.83	.18	.53	1.54	4.47	2.93
Deck Castings	7	30.23	6.90	20.70	57.83	484.32	426.49
Driving Boxes	4	2.10	4.20	1.80	8.10	105.48	97.38
Driving Box Lugs	10	1.08	.33	.88	2.29	6.90	4.61
Frames	2	5.11	1.25	4.20	10.56	57.84	47.28
Frame Cross Brace	1	2.59	.60	1.80	4.99	21.75	16.76
Eccentric Blades	5	.96	.21	.86	2.03	5.44	3.41
Eccentric Crank	1	.19	.05	.15	.39	12.74	12.35
Guide Bars	69	99.52	28.91	86.33	214.76	423.03	208.27
Guide Yoke	1	.66	.10	.30	1.06	9.74	8.68
Levers—Combination	17	2.66	.60	1.73	4.99	32.37	27.38
Links	33	3.44	.89	2.35	6.68	36.41	29.73
Link Hangers	12	1.36	.30	.90	2.56	3.24	.68
Link Saddles	2	.59	.10	.45	1.14	8.32	7.18
Miscellaneous	6	1.48	.19	.50	2.17	4.86	2.69
Quadrants—Teeth	3	.28	.05	.23	.56	2.43	1.87
Rods—Main	9	2.48	.75	2.18	5.41	9.99	4.58
Rods—Side—Grease Plug Holes	106	20.61	2.70	10.03	33.34	89.04	55.70
Rods—Side—Spade Pin Holes	1	.65	.23	.68	1.56	12.29	10.73
Rod Straps	7	4.16	1.10	3.30	8.56	53.78	45.22
Reverse Lever Heels	3	.57	.15	.45	1.17	7.80	6.63
Reverse Lever Latches	6	.66	.13	.53	1.32	11.55	10.23
Spring Saddles	8	2.19	.60	1.80	4.59	22.99	18.40
Spokes—Driving Wheel	9	6.01	1.50	4.20	11.71	42.50	30.79
Shop Tools and Machinery	2	.72	.13	.50	1.35	6.00	4.65
Tail Sheet	1	.33	.05	.15	.53	1.50	.97
Tumbling Shaft	2	3.13	.85	1.00	4.98	49.21	44.23
Tender Truck Equalizers	8	4.18	.80	3.15	8.13	78.30	70.17
Transmission Hangers	6	.57	.10	.38	1.05	1.38	.33
Total	487	$228.22	$60.62	$175.52	$464.36	$1,839.54	$1,375.18
Net saving for month							$1,375.18

Most of the building up operations should be done with ⅛-in. electrode. The use of smaller electrodes is not economical owing to the slow speed. The use of the larger bare wire electrode is not good practice owing to lack of control of the metal.

Welding Boiler Plate.

Welding in the firebox should be done with ⅛ or 5/32-in. electrode. The best metal is obtained in the weld with these sizes. The amount of heat is as small as can be economically used. It is evident that owing to expansion and contraction difficulties, the quantity of heat it is possible to use in welding flues or firebox sheets is limited.

The ideal preparation of a set of flues for welding is as follows:

1. Put flues in exactly as if they were not to be welded.

2. Fire the boiler, or, better still, send the engine out for a run. The object is to burn the oil out from under the beads of the flues.

3. The flue sheet should then be brushed with a stiff wire brush or sand blasted. The object is to eliminate, so far as possible, the scale of oxide on the flue sheet and flues. Iron oxide is not a good conductor of electricity and causes difficulties with the arc which in turn may produce a poor weld.

The welding of 2-in. flues is done best with ⅛-in. electrode. On sand blasted flue sheets 90 to 100 amperes is enough current. Flue sheets that have a thick coat of oxide

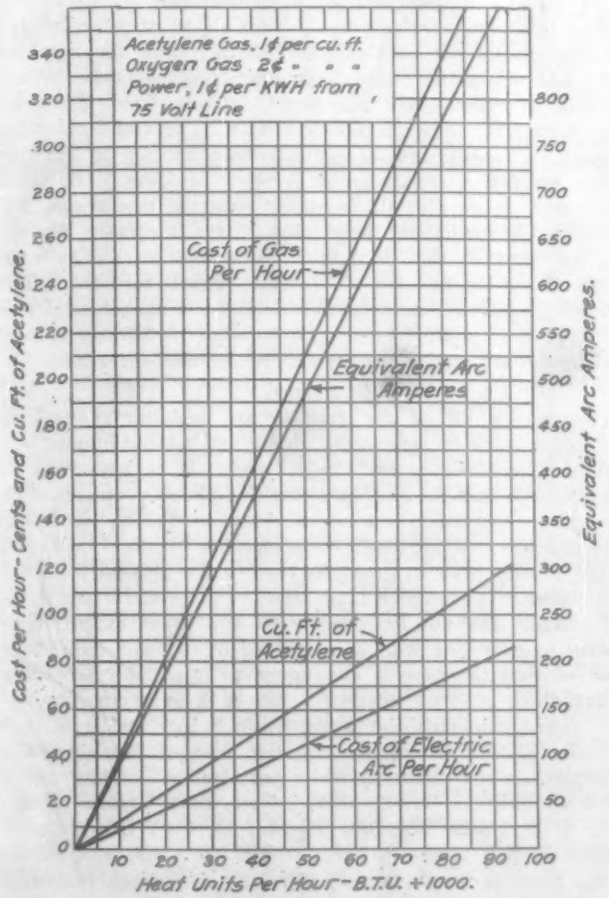

Acetylene Gas, 1¢ per cu. ft.
Oxygen Gas 2¢ - - -
Power, 1¢ per KWH from 75 Volt Line
Cost of Gas Per Hour
Equivalent Arc Amperes
Cu. Ft. of Acetylene
Cost of Electric Arc Per Hour
Cost Per Hour - Cents and Cu. Ft. of Acetylene.
Equivalent Arc Amperes.
Heat Units Per Hour - B.T.U. ÷ 1000.

Fig. 2. Curves Showing Comparison Between Cost of Gas and Electric Welding Based on Heat Units per Hour

require from 120 to 130 amperes on the size wire. Five-in. flues should be welded with ⅜-in. electrode with 120 to 140 amperes depending upon the condition of the flue sheet.

Cracks and patch seams offer the most difficult problems to the operator. A crack should be located and at least two inches beyond each end a ½-in. hole drilled. The edges of the crack should then be beveled so that the operator can get at them to make the weld. On horizontal cracks, the lower edge does not need to be beveled, but should be chipped to give a square edge. The upper edge should be beveled at least 45 deg. Vertical cracks should be beveled from 30 deg. to 45 deg. on each side. The less material removed from the crack the better. All welds should be made with the least possible amount of metal between the edge of the original material.

If the crack or seam is a long one, the metal should be put in alternate sections 4 in. to 6 in. long. The operator should put one layer of metal in each of these alternate sections starting near the center of the seam or crack. The open sections can then be filled starting at the coolest point. Successive layers of metal can then be applied until the seam is completed. Wherever possible, at least 30 per cent of reinforcing should be applied so that the cross-section through the weld is 30 per cent greater than the section of the original plate. After each layer of metal is welded into the seam, it should be thoroughly brushed with a stiff wire brush to remove as much of the oxide as possible. Where the sand blast is available and can be used on the job the results will justify the expenditure of time necessary to clean the metal between layers. The same general care should be taken in the welding of locomotive frames as in the case of the boiler plate of the firebox.

Aside from the use of judgment in the application of the electric arc welding process, there are three rules which the operator must observe to get the best results in welding: 1. Hold a short arc. 2. Use a low current. 3. Always work on clean metal.

Cost Data.

The following cost data were obtained in one of the largest locomotive shops of the country. Period covered seven months, cost of electric power 2 cents per kilowatt hour:

Electric Arc Welding Equipment.

The power required for electric arc welding at the electrodes is low voltage direct current. The metal arc requires from 75 to 180 amperes at 15 to 30 volts. The carbon arc requires from 250 to 400 amperes at 40 to 50 volts. The only object in using welding equipment is to get power of this nature economically. So far as welding is concerned, quite as good work can be done with resistance ballast across 250 volts direct current, as is possible with the most refined and highly developed equipment.

There are two types of equipment on the market which may be described as constant voltage type and variable voltage type.

The constant voltage type is a motor generator set which takes power from the shop mains and delivers on the gen-

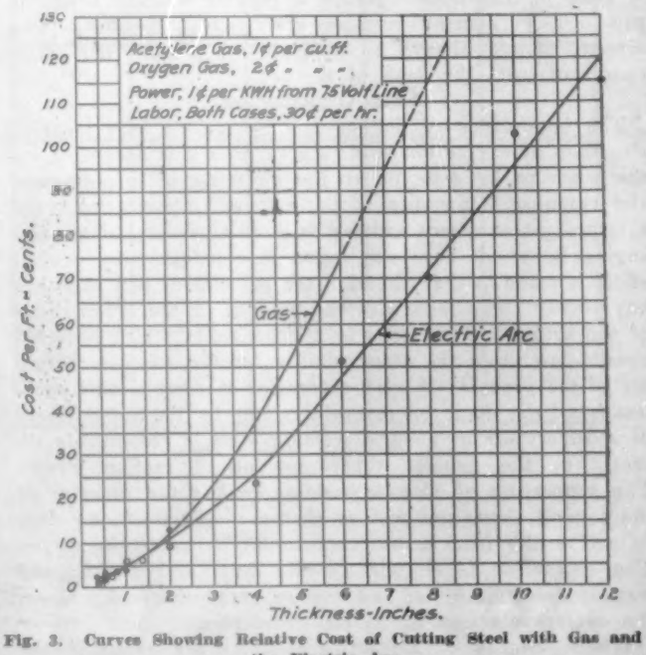

Acetylene Gas, 1¢ per cu. ft.
Oxygen Gas, 2¢ - - -
Power, 1¢ per KWH from 75 Volt Line
Labor, Both Cases, 30¢ per hr.
Gas
Electric Arc
Cost Per Ft. = Cents.
Thickness-Inches.

Fig. 3. Curves Showing Relative Cost of Cutting Steel with Gas and the Electric Arc

erator end a practically constant low voltage. A resistance ballast is used between the generator and the welding arc to limit the current at short circuit. The power used in the resistance ballast is of course wasted. The low voltage direct current power is carried over the shop on heavy cable to the welding outlets.

The variable voltage type is a motor generator set which takes power from the shop mains and delivers on the generator end the voltage required for welding without the use of resistance ballast. The inherent characteristic of the generator is such that the short circuit current is limited without the use of resistance ballast. Inductive ballast is used to stabilize the arc. This type of equipment is made only in single operator units. With this type of equipment the low voltage distribution system may be eliminated. The motor is fed directly from the shop lines.

Single operator units of either type may be made portable. Large constant voltage multiple operator units must be located at definite points, although the resistance banks may be made portable if the low voltage distribution system is made heavy enough to eliminate interference between operators due to line drop.

The desirability of any installation of welding equipment is based on the following points: 1. Realiability—flexibility. 2. Operation cost. 3. Cost of the installation complete, including wiring, apparatus and installing.

At the present time it appears that 150 amperes capacity for each 5 tracks in a locomotive shop or for each 15 tracks in an engine house is sufficient capacity.

Protective Shields.

An operator's shield for building up operations which is very satisfactory can be made of a soft pine board with a small slot in it for the protective glass. Firebox work requires a head shield which should be made of hard fiber. The color combination in the protective glass is of importance. Two red glasses and one blue glass or two reds and a green give good results. Special glass put out under various trade names is also satisfactory. As a rule the operator tries several combinations until he gets one which seems to suit his eyes best.

While the operator is working outside the firebox, the other men should be protected from the light of the arc by screens. Portable screens should be used where work is done on the floor. Where a regular welding bench is provided, permanent curtains should be provided. The screens should always be designed to protect the crane operators from the flash of the arc.

Shop Organization.

The importance of the welding operations in a locomotive shop or engine house is so great that it is necessary for the work to be done under the direction of a competent and responsible member of the railroad organization. On a large system where welding is done at several shops and engine houses it has been found that unless some special effort is made in that direction the practice of one shop has not usually conformed with the practice of the other shops of the system. This leads to a situation in which it is impossible to place the responsibility for the success or failure of the process. A very successful solution to this problem has been made on several systems by the appointment of a supervisor of electric welding who is responsible directly to the general superintendent of motive power. The supervisor of electric welding makes the practice of the several shops uniform so that the failure of one shop to get results from a process can be traced to its origin. The supervisor of electric welding must find a successful way of doing each job and require every shop to perform the operation according to his instructions.

When failures of certain operations are reported the supervisor of electric welding can readily locate the trouble since it can only be due to the failure of some particular shop to follow his instructions. In this plan the operators in each shop are responsible to the local shop authorities in the usual way and are responsible only to the supervisor of electric welding for the manner in which they perform the welding operations. The operators in a given shop are usually in charge of a foreman operator, who assigns them to individual jobs and is responsible for their following instructions of the welding supervisor.

Operators are obtained in most cases from a shop organization. On roads where an apprenticeship training is provided most of the operators are men who have just completed the apprentice work. It is desirable to have operators who have had general experience in a railroad shop. In shops which have a local electrician the care of the electric arc welding equipment is handled by the chief electrician. In engine houses the operator of the equipment is usually trained to give the equipment whatever care is necessary.

Standardization of Operations.

The tendency at the present time is to standardize the welding operations in the same manner that the machine shop and other operations have been standardized. Where welding operations are thoroughly standardized the work can be paid for on a piece work basis. The standardization of welding operations is comparatively simple on systems which employ a supervisor of electric welding. On other roads it is more difficult to standardize the operations, but the necessity for having them standardized is greater. Ninety-five per cent of the electric arc welding done in railroad shops is on operations which can be standardized. The following factors should be determined for each job of this nature: 1, size of electrode; 2, kind of electrode; 3, current in the arc, and 4, time required for the operation.

Summary.

The application of the electric arc welding process to the repair work in locomotive shops and engine houses is a profitable proposition for the railroad. It is important to the railroads that the shop practice and shop organization be reduced to the most economical basis at the earliest possible moment. While the saving effected by the application of the process was so great that up to the present time the application of scientific management to the electric arc welding practice has not been made to any great extent, it is evident to everyone who is interested in railroad shop management that the time is coming when it will be necessary to cut down cost of this work to the lowest possible figure. This can only be accomplished by intelligent co-operation of the railroads along the lines of furnishing information on the results of their practice.

Sub-Committee: H. C. Meloy, New York Central, chairman; S. T. Sikes, Southern Pacific; D. C. Wilson, Union Pacific; Robert Kinkead, Lincoln Electric Company; C. H. Quinn, Norfolk & Western; J. H. Bryan, *Railway Electrical Engineer.*

ANNUAL MEETING OF ACETYLENE ASSOCIATION.

The International Acetylene Association held their regular annual meeting in New York City, October 24th and 25th, there being an unusually large attendance. It is said this was one of the most progressive gatherings ever held by the association and much constructive work may be looked for during the coming year. Among other important matters discussed was the question of co-operative welding schools, and a plan is under consideration which may bring about the establishment of several such schools in the near future. Mr. J. M. Morehead was succeeded as president of the association by Mr. A. F. Jenkins, of Baltimore, Md. Mr. J. F. Earl is vice-president and Mr. A. Cressy Morrison will continue to be secretary-treasurer.

HOW TO TELL MALLEABLE.

If the break is clean malleable will show two distinct colors, white in the center and black on the outside, this black ring extending into the casting from 1/16 to ¼ inch. Malleable will spark a little but enough to show it is not cast iron, which does not spark at all.

Manufacturing Work for the Job Welding Shop

The growth of the welding industry is along manufacturing lines. To be sure its value in repairing is great and perhaps it is because of its wide scope in salvage work that the manufacturing end has in many instances been neglected.

This department is for the purpose of showing manufacturing uses of welding and quarterly we will pay $25 for the best suggestion received of construction work which may be done by the job shop.

$25 FOR YOU.

The ordinary job shop has many periods when repair work is slack; when the workman "swings his heels" because of nothing to do. Because of his experience, the job welder is best fitted for construction work and in every community there is usually work of this nature to be done—if the shop but knew it—which would keep the shop busy during dull periods, give the operator more experience and help materially in widening the scope of the industry.

It is a strange fact that welding is often—too often—thought of simply and solely as a repair process. We want to do our part toward making it more widely known as a manufacturing one.

Herewith is presented to you an opportunity to help yourself, your brother welder and the industry by telling what work you do or have done or know about of a construction nature. For the best suggestion we publish, we will each quarter pay $25.

The only condition is that the welding must describe new work—not repair work. Be as brief or as loquacious as you will, but describe the work fully enough so that your brother welder will understand. A sketch may be desirable—a rough pencil one will do—and perhaps time and cost of the operation would not be objectionable. Each three months, we will pay $25 for the best suggestion. Spelling, grammar or punctuation are not material—it's the IDEA that is wanted.—Editor.

ICE CANS.

Editor:

One of the profitable, and apparently practical, construction jobs for the welding shop is that of making an ice can.

Ice plants are quite plentiful—and they all must have cans. The largest part of these cans are today made from galvanized iron of about 16 gauge, with the side seam and bottom riveted and then these rivets are afterwards soldered. Strap iron is riveted all the way around the top with one small hole on each side to insert a bar to facilitate lifting the can out of the brine when the freeze is complete.

The objections against a riveted can are numberless and with the combination of rough handling and their immersion in water, considerable leakage is inevitable. Any ice plant must spend lots of time in soldering up bruised and dented and leaky cans.

Quite recently it has been found that black iron (not steel) may be advantageously used without galvanizing and painted with a special preparation known to the ice trade; this black iron well resists rust.

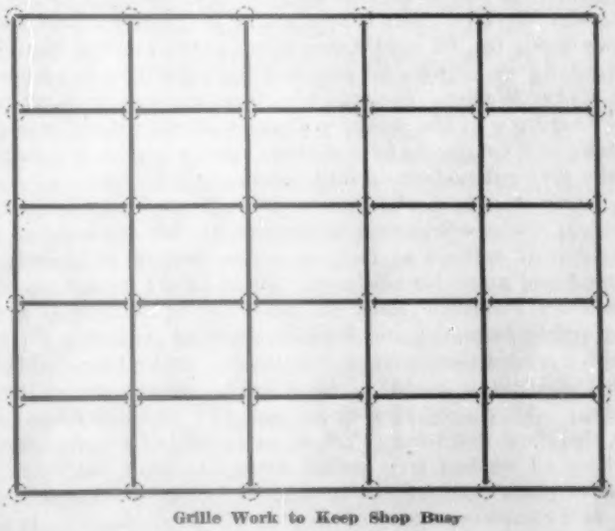
This opens the way to an all-welded can, preferably made from about 14 gauge material. The long weld may be made at one corner and the bottom may be made of flat stock, reinforced all the way around with a 1x¼-in. strap, spot welded or tacked; or if sufficient quantity orders could be secured a flanged bottom could be purchased.

Talk with the ice manufacturer in your town, Mr. Welder, and see if he wouldn't appreciate a can which doesn't have to be soldered continuously and which when bruised or dented will not leak. H. R. Babcock.

GRILLE WORK.

Banks, offices and stores, as well as timid women (and perhaps men) are customers or prospective customers of the job welding shop.

For the protection of windows—to prevent someone entering the premises—yet giving light and air, it is desirable to



Grille Work to Keep Shop Busy

have a grille. In the old days it was made by the blacksmith, laborious work and costly, but today it should be constructed by the welding shop.

They may be plain or fancy, heavy or light, but their construction is simple. Simply remember that all welds are butt welds and cut the pieces—never overlapping one. A very simple design would be as shown herewith. It is not necessary to weld the bars all the way through, less than a quarter of an inch from each side being sufficient. No beveling is essential, since the force of the flame will easily penetrate to a sufficient depth. This is good paying work, since there is practically no competition, methods of manufacture other than welding offering the objection that the grille may be taken apart; but the all-welded grille may be entered only with the cutting torch. F. C. Sanborn.

The Welding Engineer

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Copies mailed as samples to prospective subscribers	1,700
Copies retained at office of publication to fill new subscription orders, etc.	290
Copies for office use	10
TOTAL	4,100

VOLUME 1. NOVEMBER, 1916. NUMBER 11.

Certificates of Proficiency.

WE have observed that there are quite a number, yes a considerable number, of welders in this country who would have you know that they are what might be termed Master Welders. This is as it should be. We wouldn't give two hoops for the welder who didn't either consider himself some shakes, or who did not cherish an ambition to become a Master Welder. The man who lacks ambition to climb to the very top of his chosen profession should change professions. Of course the best of them make mistakes, but that's why they put rubbers on lead pencils.

Every once in a while we receive a letter from some ambitious reader who wants to demonstrate his efficiency as a welder—is willing, in fact, to appear before an examing board and prove his efficiency. These letters have come to us more frequently since we published an illustration and an article describing the British system of rewarding merit with a graded Certificate of Proficiency. So we have decided that something ought to be done to reward the skillful welder who desires recognition, and *The Welding Engineer* is, therefore, preparing to create an examining board, before whom all welders may appear for examination and rating. These plans are not yet completed, but in the December issue a complete account of the plan will be announced. It is sufficient to say that examinations and ratings will be under the direct supervision and control of *The Welding Engineer*.

Co-operation of Welding Interests

JUST before John Hancock put his famous signature to the Declaration of Independence, some one said solemnly, "Men, in this hour, let us hang together." "Yes," came the pointed retort, "for if we don't—we'll all hang separately." Because they hung together a new nation was possible.

Unity, or union, means nothing more or less than co-operation, and co-operation makes possible the seemingly impossible. Co-operation concentrates individual strengths and makes one mighty strength.

There should be better and stronger co-operation in the welding industry, a concerted movement, in fact, to carry the doctrine of the efficiency of welding and cutting to the remote corners of this continent. There is plenty of business in this country for manufacturers of first class articles and there is going to be more business. The art of welding and cutting is in its infancy, the field is just beginning to broaden out—find itself in fact. Just how long this infantile period will continue is a matter of conjecture, but unless we have co-operation the period will necessarily be lengthened.

There is a great amount of constructive work to be done by welding interests before we take our rightful place in the country's affairs as a first class industry. Small grievances and difference of opinion should be laid aside for the common good.

Writing for Trade Papers

EVERY man, whatever his occupation, is able to write if he is observant of his surroundings. Every editor mourns the fact that many practical men, whose ideas would benefit a host of others, are either too busy to put their thoughts on paper, or are too busy to write. Others who make the attempt use too many words. A writer in a well known technical paper says:

It is not necessary that you should be a born editor in order to write successfully for a trade paper or a technical journal. Write simply as you would talk—be natural. Before you start to write have the idea clearly in your mind, and tell it in as few and simple words as possible. Never attempt to write about a thing that is not clear to you, as you cannot expect to succeed then in making it clear to others.

In order to write interestingly one must have something to say and, as stated before, any intelligent man can find something of interest and importance in his everyday work that others will be glad to know. Don't be afraid to express your thoughts, but when writing make your sentences short, remembering that a short sentence is always more easily understood by the one who reads. The points to be remembered are: Have something to write about; understand it clearly yourself, and then put your thoughts in as few and simple words as possible.

A Campaign of Education.

THE job welding shop must be continually on the alert for new business. The process of autogenous welding is so new that the welder must constantly bear in mind that people who should be familiar with it and its possibilities many times know nothing about it.

The situation is directly up to the job welding shop to remedy. If, for instance, he who is called into a factory to quote for welding a broken casting, he should invite himself to walk through the plant with a view of making suggestions as to how welding could be applied in that particular industry.

Carrying an advertisement in a local paper might help, but the big results are always secured by personal canvass by a practical man. Very few industrial establishments can fail to "give up" some work when the welder who is enthusiastic and practical gets through an inspection trip.

Educating the Young Idea.

EVERY manual training school in America should teach the young idea something about welding, by means of some one of the modern methods. Such study should also enter into the curriculum of every student striving for a mechanical or engineering education at our universities. We believe manufacturers would find it profitable to unite in a campaign having for its object the advancement of welding knowledge among the young students of this country.

Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

THAT EXPANSION PROBLEM.

Editor:

On page 24 of the October issue, G. A. S. K. propounds the following:

"B claims that a bar, heated and allowed to cool naturally, contracts more than it has expanded and is shorter than at first. A says he is wrong."

This is but a part of the query and your answer to this portion is as follows:

"When a bar of iron or steel is heated and allowed to cool naturally, the contraction is greater than the expansion, the bar being shorter. In heating iron or steel it must be constantly remembered that the work is larger at the time it is manipulated than it will be when cool. Allowance must therefore be made for shrinkage."

Contrary to all rules of physics and violating one of the elemental rules which beginners in welding should know: that each metal will expand a certain definite amount as a certain definite raise in temperature occurs and will cool in exactly the same ratio. Why, Mr. Editor, if your answer were correct think what would happen to all our bridges, railroads and steel office buildings. Metal must expand in summer, when it is exposed to the sun's rays and of course contracts in winter so that if contraction is greater than expansion, eventually our steel structures would disappear.

The balance of the question as to what caused the warpage is rather vague and could hardly be intelligently answered without a sketch, but A and B will be able to decide what happened by bearing in mind the following.

When metal is heated, it expands and this expansion takes place the easiest way. If, for instance, the bar referred to is simply heated in one spot to a welding heat, the ends of the bar would probably not move but expansion would take place toward the center of the weld, resulting in warping the bar.

In welding a thick and a thin piece together, it is to be remembered that some provision should be made so that both will cool at about the same speed, since the rapid conduction of heat by the heavier piece will twist or warp the lighter.

Your explanation that the bar is three-eighths shorter when welded after figuring out the shrinkage is clever but cannot be borne out by facts. The bar should not be any shorter, unless the ends were rigidly held, but the chances are that it did warp because of improper heating.

You also state that the welding temperature of iron is 1,700° F. In compression welding, this is true, but not in autogenous. Here the welding heat is the melting heat, varying with the carbon content, but on bar iron approximately 1,000° F. more than you state.

I am not familiar enough with spot welding to determine whether the welding of quarter inch material to 16 gauge is at all practical; it would seem that this would present difficulties almost insurmountable. Irrespective of the process used in welding, expansion and contraction should be understood by the operator of the system and it seems to me that instead of running into higher mathematics which to put it mildly are far fetched—almost leading me to agree with the Southern darky who said that while figures don't lie, liars sure do figure—the principles of expansion and contraction may be much better understood by simple diagrams and the avoidance of technical terms. Let's keep our feet on the ground in treating these expansion and contraction problems so that all of us can understand each other. Failure to grasp the principles involved is, I believe, responsible for about seventy-five per cent of the unsuccessful repair welds and one of the chief reasons for this failure is the lack of unanimity of simple expansion and contraction effects.

M. Keith Dunham.

New York, Oct. 30, 1916.

Editor: In your October number of the *Welding Engineer* you state that iron or steel heated and then allowed to cool naturally, will be shorter than it originally was. This I believe to be an error on your part and, if such, should be corrected through the columns of your paper.

In thirty years of blacksmithing I have never found iron or steel to contract more than it expanded unless cooled in water or oil. But after a year's experience in oxygen-acetylene welding I am tempted to think that it does. The reason it seems so is that either the fresh metal added hot occupies less space when cold, or the piece being welded is so confined by other parts that it has no room to expand and so upsets or squeezes the hottest part together; the same way a short heavy bar would if the ends were held absolutely immovable and a welding heat applied to the center.

I might state that if your answer were true blacksmiths would not be obliged to upset or cut and weld tires in order to shorten them. All they would have to do would be to heat them, slip them on the wheel and let nature do the rest.

F. L. Snyder.

OXYGEN AND HYDROGEN.

Editor:

Will you kindly publish some information in an early issue of your paper on the following subjects:

1. Hydrogen. The appearance and regulation of the flame, and how it differs from the acetylene flame.

2. Why cannot cast iron be cut like steel?

I have read that this is because the oxides of cast iron melt at a higher temperature than the iron. While the oxide of steel has a lower melting point than that metal. Now, what I want to know is: What element in cast iron causes this? Is it silica? This is the only element in cast iron which is not also present in steel to a greater or less extent.

3. Also state about how much hydrogen is used in proportion to oxygen in welding.

M. McQuaig.

Answer: 1. The oxy-hydrogen flame is of fainter luminosity than the oxy-acetylene, due to the absence in the hydrogen of any carbon, and, therefore, the much lower flame temperature. The brilliantly blue white cone of the oxy-acetylene is replaced by one of dark blue, rather difficult to adjust. The proper regulation of the flame depends largely upon the construction of the torch, and requires considerable practice. Directions of manufacturer as to pressures should be carefully followed.

2. Your understanding of why cast iron cannot be cut with oxygen is correct. The element which bothers you is carbon. Of course this is also present in steel, but not to such a large extent as in cast iron. As the carbon content increases the melting point of the metal decreases, and in the case of cast iron, so much carbon is present that the melting point of the metal is considerably below that of the oxide. A steel of extremely high carbon would not respond to the oxygen cutting process for this reason.

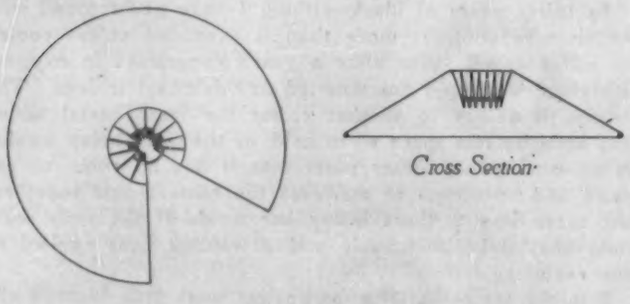
3. It depends upon the metal which is welded. To secure the best results in steel welding from three to four feet of hydrogen to one of oxygen. On other metals this excess of hydrogen is not so important, and the proportions then would be about two of hydrogen to one of oxygen.—Editor.

SHIELD FOR THE HANDS.

Editor:

As I am a new comer at the welding game, possibly the following scheme may be old to the trade, but it was the result of some very hard thinking on my part.

I had some blow holes to fill up in a sort of drum-shaped base casting, some five feet in diameter, and weighing thirty-six to thirty-seven hundred pounds apiece. The torch was a standard make twenty inches long and rather short for the job in hand. After burning my knuckles several times with



Shield for Hands

reflected heat, even with asbestos mittens, I decided that some other form of protection for my torch hand was very much in order.

As a result of sleeping on the problem, I tried a bright tin funnel-shaped reflector, about six inches in diameter, and with a hole in the center large enough to slip over the torch head, and spring tight on the handle, something like unto the following:

Each center sector is bent back upon itself, and when a spring ring is slipped over one sector and under the next with the ends bent over to retain the ring it makes a firm yet elastic grip on the handle of the torch for the reflector.

A torch equipped with a reflector of that style can be used with the bare hand where it would be almost impossible to use a short torch at all, owing to reflected heat burning the knuckles.

Another reflector with a small hole for the welding rod comes in handy in some situations, although the less rigging one uses the better.

George W. Scudder.

WELDING CHURCH BELL.

Editor:

Some time ago we welded a large 1,600 pound church bell. It seemed all right and rang for a week all right. Now it has cracked again, right above the weld. The bell is 3½ inches thick. We made a V in the crack and filled it with bronze. We had a large gas torch going inside the bell, and got a good heat all over the bell. The job must be done again, and would like any suggestions you care to make.

A. Gingrass.

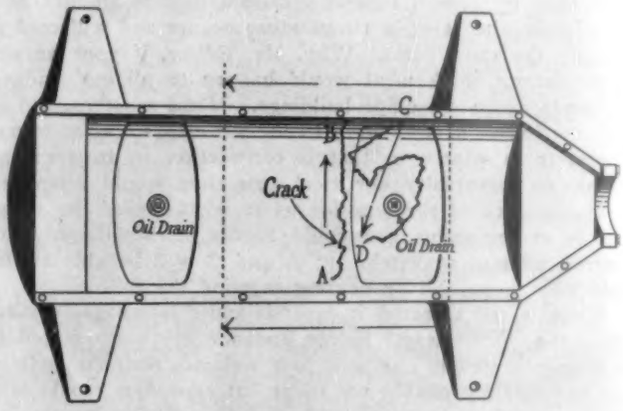
Answer: If all the necessary points are observed in welding brass or bronze excellent results may be obtained. In your case follow these instructions:

The cracked part is first beveled to a 45 degree angle. The extension of the crack is prevented by drilling a ¼-inch hole in its theoretical extension. The bell is then heated on a low charcoal fire, carefully watching that the temperature is not raised too high. Now weld with Tobin bronze rod (¼-inch) and use Standard brazing flux, taking care to weld in small layers about ¼-inch at a time, until the line of welding is slightly overcharged. After welding allow bell to cool slowly. Then, in order to obtain the original tone, reheat moderately, followed by tempering in cold water. Remove excess metal and bell will be as good as new.—Editor.

CAST IRON CRANK CASE.

Editor:

This is a cast iron crank case, which will give us all a lot of trouble if not heated just right. To make a good job on this kind of a cast iron crank case build a brick furnace about six inches on each side of crack. Then cover the part which



Cast Iron Crank Case

you have brick around with asbestos. Then heat with charcoal fire or oil torch. I have an oil torch which is mighty handy, also three Davis torches. After the small place is cherry red weld as follows: First, begin at A and weld up to B, then start at C and weld back to D. Heat again as before and cover up, allowing casting to remain about one hour. This method of preheating is good and saves time and keeps crank case from warping, which they will do nearly every time all over. It should be remembered that this is the bottom half of a cast iron crank case.

A. C. Carlisle.

CAST IRON FLUX.

Editor: Can you give us a receipt for a cast iron flux that we can use to make the work soft? Most all of our work is for machine shops and manufacturers and they find fault with the welds being hard. We use the oxy-acetylene and also the hydrogen process. Fuller Bros.

Answer: We are unable to give a good formula for cast iron flux, and we would not do so if we had one. We have

two reasons for this. In the first place, the necessary chemicals are expensive, and if the flux is to be a good one, a chemist should prepare same. A very slight variation in the mixture would destroy the value of the flux. A pound of good flux will weld a ton of castings, so why not buy a flux of proven value? Many of the advertisers in *The Welding Engineer* can supply a first-class article.

The flux you are using, however, may not be the cause of the hardness in the welds. This may be caused by the too quick cooling of the welds. Each time cast iron is melted (or welded) it becomes harder and unless particular care is used to allow it to cool slowly, the proper rod and flux will not prevent this hardening action.—Editor.

WELDING BOILER TUBES.

Editor: I would appreciate information regarding the welding of boiler tubes, that is, lenthening same by welding short pieces onto those which are too short for boilers, and whether the oxy-acetylene process is extensively used in this direction in the States.

Any information you can furnish in this direction will be highly appreciated as we have several jobs in view which can be filled providing proof can be furnished that this process is satisfactory and the tubes have passed inspection.

As regards myself, I am fully confident of success in this line so trust you will be able to help me out in the way of backing me up with above information.

T..... Welding Co.

Answer: The Chicago & North Western Railroad is welding ends on all their superheater tubes and are also welding the small defective tubes with the oxy-acetylene method. This process is practicable if good operators are used. However, the majority of boiler shops are welding ends in boiler tubes with oil or illuminating gas furnaces, and this method has been found to be cheaper for welding tube ends.—Editor.

GAUGE PRESSURE.

Editor:

Please tell me about what pressure I should have on my acetylene tank gauge, also on my oxygen gauge when welding light material, say 3/8 to 1 in. or a 1/4 x 2 in. cast iron. Please state the ordinary pressure for light material. I would also like to know what makes some welds fry, or act greasy when welding. Also, is it necessary to have aluminum in a cast of some kind when you weld it, or can it be welded the same as two pieces of cast iron? Is Thermit practical for a small shop?

U. S. Hardten.

Answer: Use 8 pounds of acetylene and 8 pounds of oxygen for 1/4-inch or 3/8-inch cast iron welding. Keep the white jet about 1/4 inch from the surface of the metal, and use a good cast iron welding flux, and the metal will run smooth and clean. When welding aluminum it is not necessary to have a cast block under work, except when filling up a large hole, when a carbon block is shaped in the same form as the article to be welded and placed under the hole.

If you expect to do big work in your shop we certainly recommend Thermit. In fact, Thermit is not limited to big jobs by any means, but is being employed in small work as well. We are sending you a back issue of *The Welding Engineer* in which the process is described.—Editor.

ALUMINUM WELDING.

Editor:

Having read an article on aluminum welding in *The Welding Engineer* by Mr. Miller, I would like to give you my method for welding aluminum with flux. I have used nothing else for over five years. In the welding of aluminum cases and all large aluminum welds I use about equal parts of asbestos and plaster paris mixed, and add enough water so it will stick together and to the case, and use it to support aluminum while welding, using flux without making a V at break or cleaning off grease and dirt, no matter how thick, unless it is out of the ordinary. Also for about the last three or four years, since we have a real aluminum flux, I have never yet seen a job come back broken in the weld. Also it can be done in a great deal less time than puddling, as after the mould is dry I weld aluminum the same way as cast iron, only it is much faster.

G. K. Armstrong.

DRIVE SHAFT HOUSINGS.

Editor:

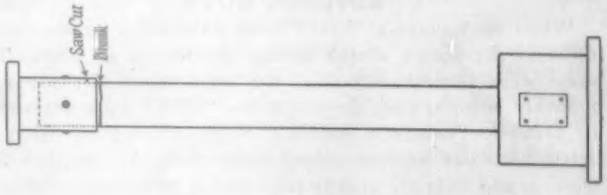
We have had quite a few drive shaft housings (not Fords) to repair that were broken as shown in the illustration, and feel sure that a description of our method of repairing these will help someone, or probably bring out some other good procedure.

It seems that these always give away at the transmission end, the steel tubing shearing off close to the malleable casting, and in some cases about one half of an inch inside of the casting.

This job could be done by placing the end in position and brazing the tube to the casting, but it could not be considered a first class repair by any means.

Again, it would be impractical to weld the tube together without any preliminary preparation, as that would necessitate the melting of the end of the malleable casting, thereby weakening its structure.

Our method is to first clean the parts of all dirt and



Drive Shaft Housing

grease, then look for parts that would be affected by the heat. If any are found, they are removed before going farther. This law should be enforced in all welding shops, as it is an old story to hear someone say they had a welding job done by some concern and when it came back the babbitt bearings were melted out, or the temper was taken out of something that should have been removed.

The end of the casting is then sawed back far enough to clear one half of an inch of the tube. Care must be taken not to saw into the tube, as this would be liable to leave a weak section.

After one cut is made, the casting is gradually turned until the cut is all the way around after which the end is knocked off bareing the tube.

The casting is then ground around the end (not tapered) to get a bright surface for the bronze. Parts are then lined up and the tube is tacked in four places.

Owing to the tube not being of heavy metal, the edges are not tapered. Welding is not completed in one direction, but welded a short distance, then started in another place and so on until the welds meet to keep alignment. Soft swedish iron is used as a filler material, and the weld after being melted through is built up to the heigth of the casting. A file is then run over the weld to remove all the scale, and Tobin Bronze is used to join the housing to the tube and to fill the space between the end of the casting and the weld making a first class repair.

J. B. Diehl.

BEVEL GEARS.

Editor: I notice in your October issue an article on "Welding A Bevel Gear." A. C. Carlisle and J. B. Diehl have given their experience on welding this gear. I wish to say that I can save both time and money on this job, as I have welded beveled gears, not as large as the one described in your October issue, but the cracks were on the same principle and I welded with a blow torch. Preheat just hot enough to save acetylene and oxygen, then weld one crack, starting on outside of rim. Let the first weld cool completely, then weld crack No. 2 same as No. 1. Start outside and finish to center; then draw torch back slowly over weld, heating almost red and finish drawing heat to outside of rim, where the last start was made. All flywheels cracked can be welded in this manner.

R. A. Raguse.

FILLER RODS.

Editor:

What kind of a filler rod would you use for welding a bicycle crank, also what kind of flux? I welded one with Vanadium steel, but had no success. Is Vanadium steel and nickel steel the same?

L. C. Hohr.

Answer: Use nickel steel rod for welding a bicycle crank, without flux. Care should be taken to bevel crank on both sides, then the flame of the blow pipe is made to approach the metal until the extremity of the small white jet licks the metal and produces melting; this without too much exaggeration, otherwise the metal is burned and the weld unsuccessful. Vanadium steel differs from nickel steel.—Editor.

EDITOR'S NOTE.

When we receive a "Kink" from a reader it is our custom to send the rough sketch to our draftsman at once. This may occur immediately after the publication of the regular monthly edition, and, therefore, the "Kink" does not appear in print for nearly a month. Right after publication we settle with our authors, compensate them, in fact, for their trouble, and bills are usually paid within two weeks after publication. So if you do not hear from us immediately after publication don't be impatient.

EDITOR'S NOTE.

We receive a great many questions which are answered by mail, and which are not published in this department. Unless requested to answer by mail it is our custom to answer all questions here. Readers desiring a prompt reply by mail, however, will receive same, and upon request questions and answers will not be published.

A NEW BOOK ON WELDING.

Perhaps it might truthfully be stated that no American industry has benefited as much from the utility of welding processes as the automobile industry. Not only has oxy-acetylene welding become one of the chief props of the automobile repair man, but manufacturers as well are employing the process in the construction of new machines.

In the past it has been difficult for the automobile mechanic to secure the right sort of information relating specifically to the application of the oxy-acetylene welding process to his work. There are several good text books on the subject, some of which frequently treat on automobile repairs, but it has remained for a well known welding engineer, Mr. M. Keith Dunham, to prepare a text book based directly on the application of the process to the automobile industry. The new book bears the title, "Automobile Welding with the Oxy-Acetylene Flame," but notwithstanding its title we commend the little book to the attention of *every welder*.

We have frequently deplored the fact that such text books as are available, while very excellent in many respects, are completely "over the head" of many welders. That is to say, a goodly portion of all text books are given over to discussions of technical problems, such as the chemical properties of gas, etc., which the welder neither understands nor needs know about. Mr. Dunham has very wisely devoted but little space to such topics, his book giving only such space to apparatus knowledge, care of generators, etc., as is necessary. Another point about this new book which impressed us favorably is the character of the illustrations. The author has been refreshingly original in his selection of illustrations and line drawings are used throughout the book. Photographs are sometimes necessary to properly illustrate one's point, but from a mechanical standpoint they are usually useless. This book also includes an index which is of great value, it being possible to locate any desired information instantly. The book contains 167 pages, is well bound and sells for $1.00. A complete table of contents will be found in our advertisement elsewhere in this issue.

MILLER'S NEW BOOK.

Members of the trade will be interested to know that a respected member of the fraternity, Mr. S. W. Miller, has brought out a new book, entitled "Oxy-Acetylene Welding." Mr. Miller will be remembered as being the owner of the Rochester Welding Works, and his writings on the subject of welding have from time to time been of great service to the trade. Mr. Miller has enjoyed a wide experience in the practical application of the process, and his success is sufficient guarantee of the reliability of the process. The book is 6 x 9 inches, and contains 287 pages and 192 illustrations. The price is $2.50, and copies may be had from The Welding Engineer. A complete synopsis of contents appears elsewhere in our advertisement of this book.

NEW BOOK ON CARBIDE.

A new book entitled "The Manufacture of Carbide of Calcium," has just been published by Raggett & Co., 30 Red Lion Square, W. C., London, England. This book was written by Mr. Charles Bingham, C. E., one of England's foremost authorities, and contains 219 pages. Copies may be had from *The Welding Engineer* upon application.

KAUTNY'S NEW SCHOOLS.

Many Americans have had the pleasure of visiting Theodore Kautny's welding department at the Royal Machine Building School, at Cologne. It is therefore of interest to state that, in addition to this school, Mr. Kautny is now in charge of a second welding school, which has been installed by the government at Karlsruhe, as well as a third school at the German Watchmakers' School at Furtwangen. Mr. Kautny has also just closed a course on welding for the plumber apprentices at Karlsruhe and a handbook for autogenous plumbing is in preparation now. It is reported that Mr. Kautny is training a large number of disabled soldiers.

NICKING STEEL BILLETS.

One of the uses of the cutting torch a little out of the ordinary is the "nicking" of billets in the steel mill.

The boy with a new jack knife would probably call this operation hacking, since the oxygen stream merely penetrates to a depth of half or three-quarters of an inch on the four sides of the billet and then either by dropping the billet or striking it with sufficient force, it breaks clean at the section "nicked."

The ordinary cutting torch is used, except that a special tip is employed because of the fact that the prime object in this operation is to save oxygen and the ordinary tip would consume too large a volume in penetrating through the entire thickness.

Modern Methods of Cutting

Modern Methods of Metal Cutting—Too Many Welders Assume Cutting to be Well Understood—Much Gas Wasted and Subject Should be Studied

By J. B. Diehl

This is accomplished with the oxy-acetylene cutting torch and equipment using 99 per cent pure oxygen under high pressure as the cutting agent on iron and steel.

Oxy-acetylene cutting differs from oxy-acetylene welding due to the fact that one is a chemical operation, while the other may be termed physical.

When welding by the oxy-acetylene process is carried out locally, if it is properly done there is no change in the structure of the metal. Therefore, it may be considered a physical operation.

In cutting by the oxy-acetylene process a fine jet of oxygen under high pressure is discharged on a piece of heated metal. This immediately produces combustion of the metal with the resulting formation of iron oxide, which is due to the chemical reaction of the oxygen on the heated metal.

While the term cutting is used to distinguish this branch of the trade from welding, it is in reality a process of oxidation.

Explaining this more simply, we may take for example the action of the atmospheric oxygen on iron or steel.

It is a well known fact that if either of these metals are exposed to the air, for any length of time, rust is formed. This is nothing more or less than oxide of iron, and the formation of this oxide will continue until the metal is destroyed entirely, although this action becomes slower as the proportion of oxide increases; due to the fact that the oxide forms a coating which partially protects the metal.

If the metal is heated, this action progresses much more rapidly.

As the atmosphere contains only one fifth pure oxygen, it may be readily understood why this action is so rapid with the cutting torch, having the metal heated and using 99 per cent pure oxygen under high pressure.

The jet of oxygen should be made sufficiently strong to blow away this oxide of iron in front of it, with the result that a clean, narrow cut is effected through the metal at a speed with which many other methods cannot compete.

The operator should always make sure he has pierced the metal before going ahead, as this insures a better job, in less time, with the lowest consumption of oxygen. Providing the oxygen is not used in excess of the pressure requirements. The usual spark shower underneath should always be looked for as the cutting is advanced, as an assurance that the penetration is complete. The oxide remaining on the under side may easily be removed.

This action proceeds too rapidly for the heat to spread, therefore the metal on either side of the cut is not melted or injured in any way, the edges being similar in appearance to those cut by a saw.

It is impossible to make a clean even cut by hand as is produced by cutting machines, owing to the unsteadiness of the workmans hand, therefore it is often advisable to use a set of rollers as a steady rest.

The Cutting Torch and Accessories

The appliances used for this work are of various designs, but are identical in principle.

The early designs of cutting torches consisted of running an auxiliary tube up on the outside of the welding torch, the tip coming close to the welding tip, and having a separate value.

This style of cutting torch was equipped with three lines of hose, making it extremely cumbersome.

The next improvement was made by connecting a tee at the back end of the oxygen valve on the torch, and connecting the auxiliary tube to this, thereby eliminating one hose.

As only one preheating jet was available, making speed uncertain due to the operator frequently losing his heat, and having to turn the torch every time the course was changed, this style gave away to the modern torch using two hoses, tip with from two to six heating orifices allowing cutting in any direction without turning the torch, no unsightly tubes on the outside and having a trigger arrangement whereby the operator has only to pull the trigger to start cutting, and when finished the trigger is shot back into place by a slight pressure of the forefinger.

High pressure oxygen regulators are necessary for heavy cutting, owing to the welding regulators being of comparatively low tension.

Economy demands that high pressure hose of good quality be used, while Safety First demands metal covered hose for cutting.

The hose if not metal covered, should be guarded carefully owing to the hot oxide falling around the operator, and should be inspected regularly for leaks as it is very easy to squander several dollars worth of oxygen with a leaky hose using oxygen under high pressure.

It is essential that the oxygen be pure with one or two per cent, as the presence of nitrogen tends to retard the cutting process. "If there were no nitrogen in the air, fires would be uncontrollable," therefore some idea may be obtained from this statement as to why nitrogen tends to retard cutting.

Where this impurity prevails, a greater pressure of oxygen is required, consuming a greater amount than where the oxygen is pure.

An increase in the temperature of the oxygen passing through the cutting orifice produces a corresponding increase in the rapidity of the cutting, thereby lowering the consumption.

Use of the Torch.

Theoretically, once the metal is ignited and the jet in operation, an auxilliary source of heat should not be required, owing to the burning of iron producing a considerable degree of heat. However, this is found difficult in practice to maintain with any degree of certainty, owing to the unsteadiness of the operator's hand, particles of metal striking the orifices and momentarily blocking the jets, dirt, blowholes, scale, etc., therefore, the necessity of several heating flames to overcome the effect of these obstacles.

Cutting by hand should be carried out with a uniform movement, the speed being determined by the thickness of the cut.

Hurry will cause the operator to lose the heat, while too slow a movement will warrant an over consumption of oxygen.

In cutting, the small cones should touch the metal for best results. (We are assuming that the cones are defined.)

If the tip is held too close, the cutting is retarded, due to particles of oxide flying onto the tip. By holding the tip too far away, the cutting action is slower, and the cut wider. However, it is essential that the tip be held farther away while piercing the metal, after which it may be brought closer.

Cutting metal over ten inches thick is better accomplished

by substituting hydrogen for acetylene. As the length of the oxy-hydrogen flame is greater than that of the oxy-acetylene flame, the heat is maintained more easily at the bottom of the cut, allowing the oxide to escape more freely. As the torch movement is necessarily slow on heavy cutting, there is less danger of injuring the edges of the metal with the oxy-hydrogen flame due to its temperature being considerably lower than that of the oxy-acetylene.

Where cutting must be started some distance from the edge, it is advisable on heavy work to make an upset on the metal with a chisel or center punch, saving considerable time in getting the cut started.

Best results are obtained if the torch is held in a position allowing the under part of the metal to be cut in advance of the top, thereby allowing the molten oxide to flow freely from the cut.

Where the cutting is allowed to take place on the top in advance of the bottom, there is a tendency for the oxide to accumulate in the cut and prevent the oxygen from coming in contact with the metal.

If this is allowed to take place, the cutting operation becomes unsatisfactory, due to ragged edges and if the part is heavy the back pressure of the heated and molten oxide will frequently melt the cutting tip.

Metals That Can Be Cut.

Steel and wrought iron are the only two metals that can be cut with any degree of success.

The welder is well aware of the fact that when metal is brought into contact with oxygen, the metal oxidizes or forms an oxide, as aluminum oxide, copper oxide, iron oxide, etc., depending upon the metal in question.

The melting point of this oxide is either higher or lower than the melting point of the metal itself. To successfully cut any metal by this method, the melting point of the oxide must be materially lower than the melting point of the metal in order to allow the oxide to detach itself and leave the edges unaffected.

Numerous claims have been made for cutting cast iron, but this has always been found to be more of a melting process than cutting.

Owing to the high degree of heat required to melt the oxide, the metal will melt first.

Low carbon steel is cut readily owing to its oxide having a relatively low melting point, while some high carbon steels cannot be cut owing to the metal melting before the oxide.

INSURING THE WEARING OF GOGGLES.

F. W. King.

The installation of safety goggles for the protection of the eyes of workmen in some instances has been found difficult on account of the indifference or prejudice of the workmen themselves. After a supply of goggles has been purchased the problem arises how best to insure their proper use, and unfortunately the objection is not confined to any class. The uneducated foreigner, ignorant of our language and unable to read even his own, can only be taught by the good example of his superiors.

Do not for a moment labor under the delusion that your particular set of men are any different from those employed by other firms who have solved this problem. They are not. All classes of workmen have been obliged to follow the ruling of various local safety organizations requiring the wearing of goggles.

First, your safety inspector absolutely must have the hearty support and backing of the firm so he can enforce the wearing of goggles. The safety inspector must secure the co-operation of foremen and shop superintendents and make them members of the safety committee. These men, including the safety inspectors and members of the firm, should always wear goggles in the shop and about the plant and thereby set an example to the men. So the first step should be the invariable practice of all heads of departments wearing goggles where there is even a possibility of an eye hazard.

In nearly every shop will be found some man or group of workmen who are acknowledged leaders and who may be of great help if they show the right spirit, and this co-operation should be had. On the other hand, if they cannot be made to see the value of the movement and show by their conduct that deliberate evasion or disobedience is intended, discharge is at once the easiest and best means of stopping their bad influence; and remember, the bigger the man the greater will be the impression on the rest.

No visitor should be permitted to go about without goggles, no matter what his rank. Discipline may include a rule that those who refuse to obey safety regulations lose any chance of promotion, it may cause suspension or exaggerated cases may mean discharge; nor should the man's ability at his particular task be any reason for allowing infringement of rules made for all.

The above is the generally accepted method used today by the largest corporations.

Others do not propose to waste any time over the question, but simply publish the rule and if a violator is caught he is laid off without pay ten days for the first offense and discharged on the second.

Showing Protection for Arc Welder

One man should be responsible for the issuing of goggles and care of the reserve stock. He should become thoroughly familiar with the proper selection and adjustment and should make sure that each goggle fits easily and properly. If this is not done eye strain will result from the frame, causing undue pressure upon some sensitive nerve.

Men cannot be expected to wear goggles if they are uncomfortable because of pressure on some sensitive nerve. Goggles may be adjusted so as to offer no interference to vision and be as comfortable as ordinary spectacles.

If your men complain of their goggles, notify us at once, giving where possible exact data covering the objection. In nearly every case the fault is lack of care in selection and

is easly remedied; in the balance the difficulty may be due to necessity for lenses ground to correct some error of vision. Many plants supply special goggles with lenses ground to prescription in those cases where a good workman has defective vision. This is a special item and is necessary in but few cases. And lastly, do not forget that a lost eye will cost the company on an average of $2,000—enough to buy 2,500 pairs of goggles.

GOLDSCHMIDT OFFICIAL DEAD.

William Cooper Cuntz, general manager and director of the Goldschmidt Thermit Company, of 120 Broadway, died on Thursday morning, November 2, 1916, at Auburndale, Mass., where he was on a visit for the benefit of his health, which was impaired by an operation for appendicitis a year ago.

Mr. Cuntz was the son of the late Emil A. H. Cuntz and Frances Cooper Cuntz, and was born at Hoboken, N. J., in 1871. His maternal grandfather, after whom he was named, was William Cooper, a well known naturalist, and one of the founders of the New York Academy of Science. His maternal grandmother, Mary Wilson, was of New England ancestry going back to the days of the Pilgrims and including officers and soldiers in the Revolutionary Army.

Mr. Cuntz was educated at the Hoboken Academy and at Stevens Institute of Technology, graduating from the latter in 1892, with the degree of mechanical engineer. He then became connected with the Pennsylvania Steel Company, at Steelton, Pa., first with the bridge and construction department, which he represented as resident engineer, in Boston, Mass., and as European resident engineer in London, England. In these capacities he rendered many important services to his company, notably in connection with the erection of the North and South Stations in Boston, and in the securing of the contract for the erection of the North German Lloyd Piers, in Hoboken, N. J. He then entered the sales department, serving as assistant general manager of sales in Philadelphia, and later as district sales manager at Steelton, Pa.

At the outbreak of the Spanish-American War in 1898, he volunteered for service in the artillery. In 1910 he was appointed by President Taft a delegate to the International Railway Congress at Berne, Switzerland, the present Secretary of the Interior, Mr. Franklin K. Lane, being the chairman of the American delegation. In the same year he severed his connection with the Pennsylvania Steel Company, to become a director and the general manager of the Goldschmidt Thermit Company, in New York. Under his management the business of this company has not only increased greatly, but equal progress has been made in the technical development of the Thermit process. His wide experience in the steel industry naturally caused him to take a particular interest in the manufacture of carbon-free metals, and it is largely due to his perserverance and initiative that these metals and alloys are coming into such general use.

Mr. Cuntz is survived by his widow, who was Miss Katherine Hughes Edwards, of Hagerstown, Md., a descendant of Jonathan Edwards, and by his two childen; William Cooper, Jr., and Emil Edwards. He is also survived by his two brothers, John H. Cuntz, of Hoboken, N. J., and Hermann F. Cuntz, of New York. His residence was at Kew Gardens, Long Island, N. Y.

Mr. Cuntz was a member of the following clubs and societies:

American Society of Civil Engineers, American Iron and Steel Institute, Engineers' Society of Pennsylvania, Engineers' Club of New York, Railroad Club of New York, Engineers' Club of Boston, University Club of Philadelphia, Chemists' Club of New York, Boston Athletic Association, India House, Transportation Club, Harrisburg Club, American Electric Railway Association, New England Iron League, West Side Tennis Club, Richmond Hill Association, Kew Gardens Civic Association, Kew Gardens Country Club, Oak Island Yacht Club, Conococheague Club, of Hagerstown Md.

A GOOD WORD FOR WELDING.

The Times Engineering Supplement in a paragraph on "Oxy-Acetylene Welding," states that "The war has given autogenous welding an excellent opportunity of showing its possibilities as a method of repair. With machines running at high pressure all over the country breakages are naturally frequent, but while users can ill afford to throw away old machines when they can see little chance of obtaining substitutes, it is often difficult to get spare parts to replace those which have failed, because the makers are too busy with other things to supply them, or possibly because the apparatus is of German origin and the parts are not made in this country. In these circumstances oxy-acetylene welding has done useful service and prevented loss of output by quickly restoring machines employed in connection with munitions to working order. British exponents of the art have further shown themselves successful in carrying out delicate work which was regarded as a German speciality. In one case an undertaking in the Midlands found it necessary to break the welds in an appliance of German make which they employed by the hundred. The metal being extremely thin, about 1/5,000 of an inch, and the insulation coming to within ⅛ inch of the point of welding they doubted whether the welds could be remade except by men specially trained for the purpose, but ultimately they found British workmen quite competent to perform the task."—*Acetylene Lighting & Welding Journal* (England).

FIRE DEPARTMENT NEEDS EQUIPMENT.

A New York newspaper recently contained an account of how a young woman was compelled to remain pinned in an elevator shaft eighty minutes before being freed. We were under the impression the New York fire department was equipped with oxy-acetylene cutting apparatus, but it would seem that the supply is inadequate to meet emergency demands of this kind.

NEW WELDING SCHOOL AT COLUMBUS.

The Columbus Practical Oxy-Acetylene Welding School, Markle & Cunningham, managers, is the title of a new enterprise launched at Columbus, Ohio. The new school will teach welding, cutting and brazing of all metals. Both Mr. Markle and Mr. Cunningham are practical men and it is thought students will be able to complete the course in from four to six weeks. Mr. Markle was formerly connected with the American Welding Company, of Chicago.

CASTOLIN.

Some months ago a reader asked us for information relative to "Castolin," a welding process which was supposed to have originated in France. We find Castolin is a process for brazing cast iron only, being manufactured by Wassermann & Company, Lausanne, Switzerland. W. H. Lilienfeld is London agent. Manufacturers state no special apparatus is necessary.—Editor.

Trade News

E. J. Sweeney, Kansas City, Mo., 1112 East Fifteenth Street, will erect a large automobile school 85x116 ft., ten stories. Necessary equipment for practical education in all branches will be installed. The total cost is estimated at $200,000.

The Julius King Optical Co., New York, are issuing Safety Bulletins each month, relative to eye accidents and how to prevent them.

These Bulletins will be sent regularly to anyone requesting same and will serve to show how accidents to the eye may be prevented.

They will be found of great value to the workman, in that they impress upon him the importance of wearing goggles to save his eyesight.

SO-LUMINUM FOR WELDING.

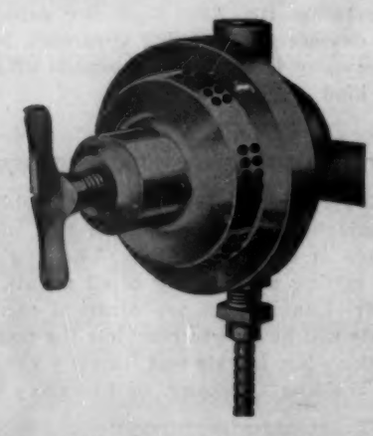
A new product which is being brought to the attention of the welding trade is "So-Luminum," a compound for welding aluminum. Simplicity is one of the chief virtues of this new product, it is said, nothing more than a gasoline torch being required. The job is simply heated, the line of welding rubbed with a wire brush or hack saw blade, and the metal and So-Luminum will combine without flux. A sample bar will be sent upon receipt of 50 cents, the manufacturers address being So-Luminum Manufacturing & Engineering Co., Inc., 1790 Broadway, New York.

NEW BASTIAN-BLESSING REGULATOR.

To prevent injury to the operator caused by the explosion of a regulator the Bastian-Blessing Company, of Chicago, has just brought out a regulator with a bonnet or spring housing as shown herewith.

It will be noted that there are a series of perforations to allow for the easy and safe escape of oxygen, if due to carelessness or accident the diaphragm of the regulator should be subjected to a pressure sufficient to burst it.

It is claimed that safety devices will actuate only when



the excessive pressure is a slow one, as for instance the creeping of the seat. When this excessive pressure is violent, which may be caused by the destruction of the seat or by the presence in the regulator of oil or some carbonaceous material, a spring safety is most unlikely to allow the gas to escape and parts of the regulator may be blown off with sufficient violence to cause injury.

To safeguard the user of oxy-acetylene apparatus, Mr. C. L. Bastian, whose many years of experience in the designing of regulators rank him as a leading authority, has so perfected this apparently simple device that as the diaphragm is pushed outward by excessive pressure, it is cut by the sharp edges of the inside of the bonnet before it has an opportunity to burst, thereby allowing the oxygen to pass through the perforations.

Thorough and exacting tests of this device show that there can be no injury to the operator even in the event of the breaking of the diaphragm.

This improvement has the approval of the Underwriters' Laboratories and will be made standard by many of the apparatus manufacturers.

HELMETS FOR ELECTRIC WELDING.

Perhaps in no other field is the subject of eye protection receiving such close attention as in the welding industry. It is absolutely impossible for the arc welder to work a second without efficient eye protection. Therefore, the new line of King "Arkweld" Helmets for Electric Welding, as manufactured by Julius King Optical Company, New York and Chicago, will interest the trade. This helmet is constructed throughout of black fiber, which is a non-conductor of electricity and much cooler than any other material that can be used, is very rigid and weighs but 23 ounces, complete with the lenses. The cap furnished with the helmet is chemically treated and fireproof, and is fitted with self-adjusting spring head band, conforming to any size head. By means of the slotted pivotal connection between the skull cap and the curve sides, the helmet can be moved from operative to inoperative positions without removing from head. In operation it's just like pushing the cap on the back of your head. There are many other new and interesting features about Arkweld helmets, and particulars and prices will be furnished upon request. This company also manufactures an extensive line of lenses and goggles for all classes of welders.

THE PRODUCTION, PROPERTIES AND USE OF THERMALENE FOR WELDING, CUTTING, ETC.

In composition and method of production, thermalene differs from any gas heretofore used for welding purposes. It is a combination produced by the decomposition of calcium carbide and hydro-carbon oils, the heat generated by the carbide being used to vaporize the oil. It is the discovery of Karl Frederick Linus Wolf, of Zurich, Switzerland, and is handled by the Thermalene Company, Chicago Heights, Ill.

At present thermalene is principally used for welding or cutting metals, in which it is used together with the proper mixture of oxygen. The nature of the gas will be better understood by first giving a description of the method of producing it. In Fig. 1 is shown a welding or cutting outfit as used in a shop. At the left is a thermalene generator, in the middle a storage tank, and at the right an oxygen tank with a torch hanging on it. Fig. 2 is a similar but more easily portable outfit used by a city water department.

A phantom view of a generator is shown in Fig. 3. To prepare this generator for operation, water is poured in through funnel A until it will run out of pet cock B, which fills the casing about two-thirds full. The generating mixture is carried in a tin can or cartridge that is inserted from the bottom into the cartridge chamber as shown at C.

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Commercial Acetylene Welding Co.

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PEOPLES GAS BUILDING
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SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

Previous to inserting the cartridge, however, care is taken to pull up the cam lever D, which closes the water valve E and prevents any water entering the cartridge chamber. After the cartridge has been inserted through the door in the bottom of the chamber, the door is closed and the bar F brought up and locked by means of handwheel G. To generate gas the cam lever on top is pulled down as far as it will go. This admits water from the water chamber H into the cartridge chamber through the center tube to the bottom of the cartridge from where it begins to work upward. The cartridge is packed with alternate layers of calcium carbide and crude oil mixed with sawdust. The water as it rises slacks the carbide and generates acetylene gas. The heat caused by the slacking of the carbide layer vaporizes the oil in the layer of mixed oil and sawdust immediately above the layer of slacking carbide and generates oil-gas. When the gas pressure as indicated by the gauge is up to 5 lb. the valve J is opened, which lets the gas enter the hose

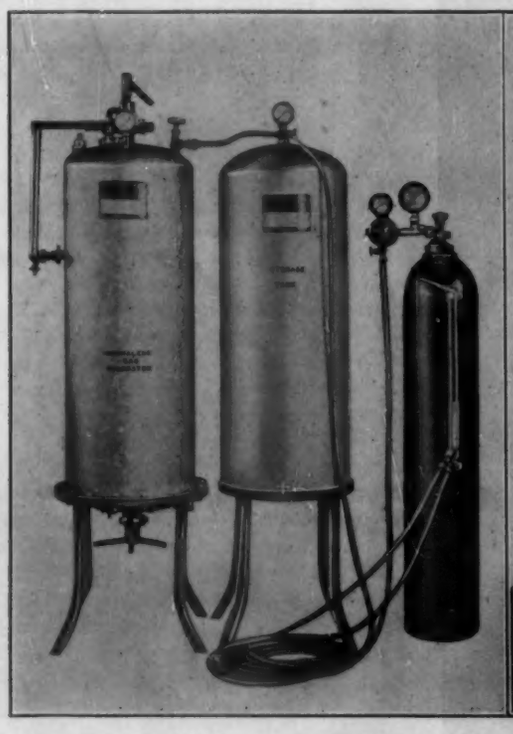

Fig. 1. Welding and Cutting Outfit

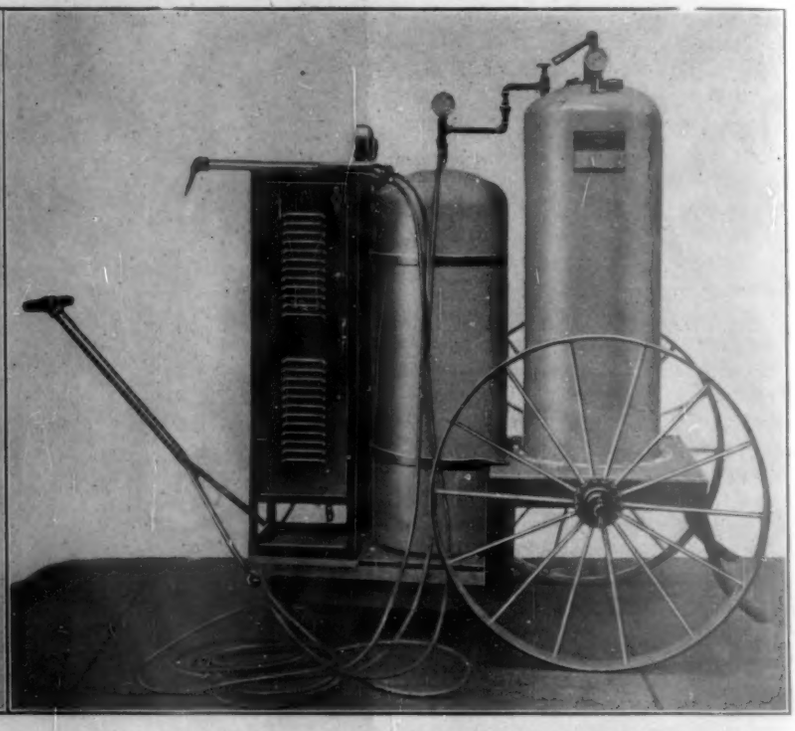

Fig. 2. Used by City Water Department

leading to the storage tank or torch. The pet cock at K is used to drain off the impurities, such as phosphor hydrogen, ammonia and water, which have been separated from the carbide gas in the process of generation. At L is a check valve, which allows gas to escape from the cartridge chamber, but effectually prevents any return of either gas or water. As soon as a cartridge is exhausted it is easily removed, carrying all the dirt and sludge with it.

With the use of a storage tank, enough gas is carried to run a torch while a new cartridge is being put in place in the generator, if needed. The maximum pressure required for welding or cutting is 15 lb. When this pressure is reached a regulating diaphragm automatically cuts off the water feed and stops the generation of gas. This diaphragm is placed at the top of the generator, on the inside, where the gas pressure acts directly on it. The diaphragm is connected to the feed-valve rod in the center so that as the diaphragm is forced upward by the gas pressure, the water valve is partly or wholly closed. It is so arranged as to be easily set for various desired pressures.

As previously stated, the cartridges are made up of alternate layers of calcium carbide and oil-soaked sawdust. Now it is well known that the volume of lime into which the calcium carbide is converted by the slacking process is greater than the volume of the carbide. Therefore when carbide is packed tightly in cartridges, as desirable, the expansion is likely to burst the case and in some cases might cause the cartridge to jam in the chamber, as well as interfere with the successful working. One of the objects, then, is to make the cartridge so as to allow for the expansion of the contents. Another is to prevent the oil from coming in contact with the carbide, as this would interfere with the action and decrease the gas output. To summarize, the cartridge components must be so arranged as to promote free action of the carbide; free action of the heat evolved from the carbide on the volatile substance; to prevent action of moisture on the carbide layers not acted upon purposely; and to promote the free discharge of the generated and volatilized gases.

All of these points, as well as a number of others, have been considered in the makeup of the cartridges, as shown in detail in Fig. 4. As made at present there are four sizes corresponding to the different outfits. The cartridge consists of a tin can of suitable size, the smallest being 4⅜ inches in diameter and 8 inches high, weighing 6 lb. and having a gas producing capacity of 25 cubic feet, sufficient for a welding torch from four to five hours. The largest size is 9¾ inches in diameter and 16 inches high, weighing 40 lb. This has a gas production of 200 cubic feet, or eight times the capacity of the smallest size previously mentioned.

Referring now to the illustration, a cylindrical screen A is first placed in the can to be filled and then a layer of carbide is placed in the bottom of the can around the screen tube. An unglazed cardboard disc B is next placed on top of the carbide. A space C, made of thin metal bent so as to lie edgewise is placed on top of the cardboard, and then a disc of screen is put over it. Sawdust impregnated with crude oil in a cloth sack made of two cloth discs sewed together is laid on the screen, then a spacer and a cardboard disc, and so on to the top, ending with a sack of oil-soaked sawdust covered with a piece of screen that has no hole in the center for the cylindrical tube. The end of the can is

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J. Frank Cutter, Cambridge, Mass
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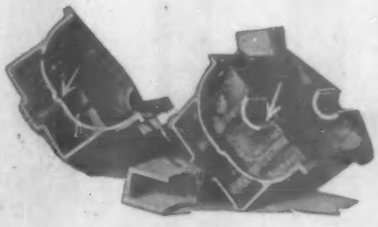

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I am interested in Imperial Aluminum Solder. Please send me one pound for trial, for which I enclose $3.00. It is agreed if not satisfactory you will refund the price as stated in your guarantee.

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closed with a cover for handling, which is removed before placing in a generator.

As previously mentioned, the water feeding in through the

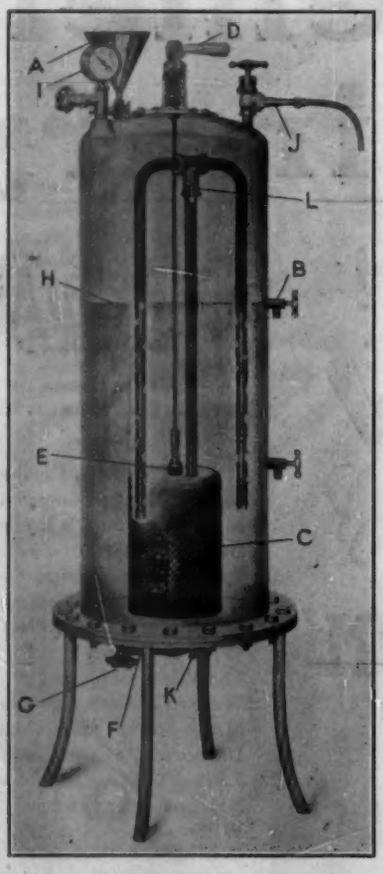


Fig. 3. Cross Section of Generator

valve in the cartridge chamber drips down through the cylindrical screen tube and starts slacking of the lower layer of carbide, the heat of which vaporizes the oil in the

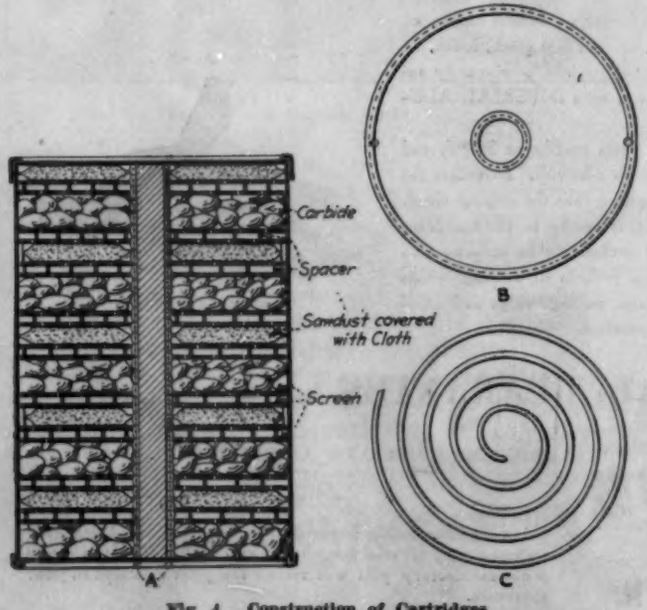


Fig. 4. Construction of Cartridges

sack above it. The cardboard discs, while strong enough to hold the layers firmly in place while dry, begin to soak up as soon as the feeding starts and consequently become soft, so as to give way under the pressure of the expanding carbide, allowing it to be forced into the spacing between carbide and the oily sawdust. This space is so calculated to keep the various layers firmly in place until the cartridge is exhausted. Another thing is that any liberated steam or water vapor must pass through the absorbent cardboard as well as the oil before it reaches the next layer of carbide;

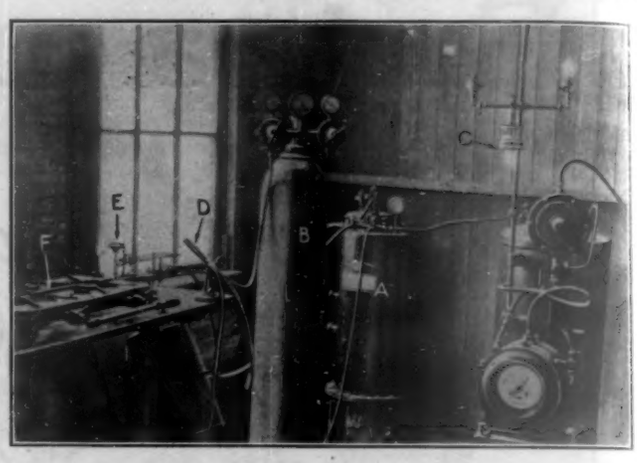
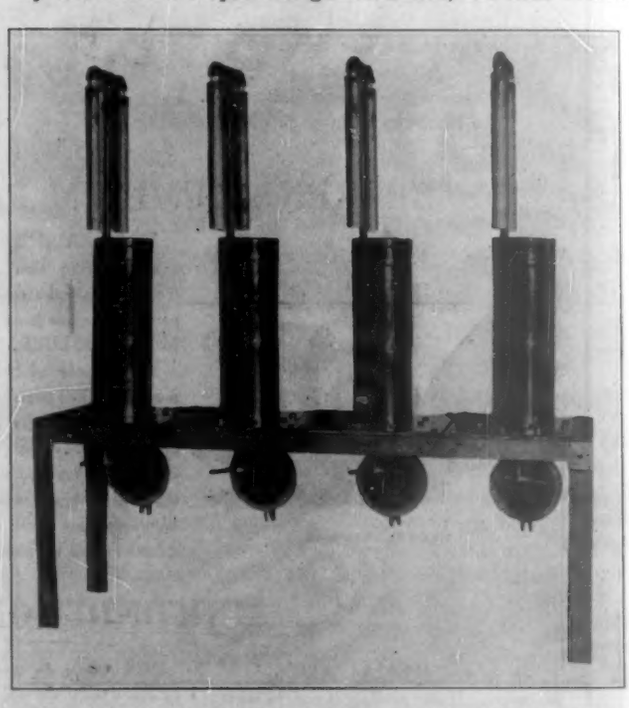


Fig. 5. Corner of Mr. Wolf's Laboratory

action of the steam on the carbide above is thus prevented. This insures that the respective layers of carbide will not be acted upon until the water becomes level with them in turn. In consequence a cartridge can remain in a generator a long time without becoming spent. The screen discs on top and bottom of each layer of oily sawdust furnish efficient volatilization and egress of the gas.

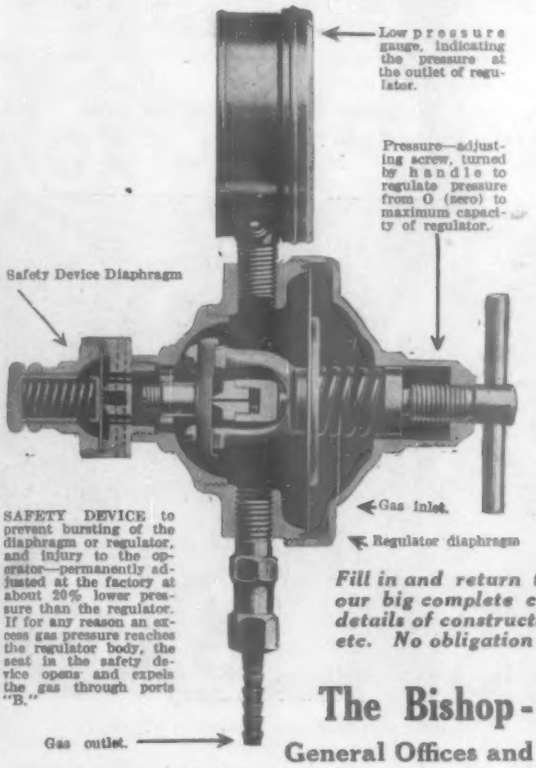
By the method of producing thermalene, the heat evolved



By Aid of Automatic Charging Machine, Generators May Be Charged Automatically

by the generation of acetylene is absorbed at the point of generation, in the production of the oil-gas. This utilization of heat serves to keep the temperature down, since the heat generated is used and dissipated by the latent heat of oil, so that radiation and absorption by water is not necessarily depended upon. The gas combination the results passes through the T pipe ends and bubbles up through

Our DIAPHRAGM SAFETY DEVICE


Low pressure gauge, indicating the pressure at the outlet of regulator.
Pressure—adjusting screw, turned by handle to regulate pressure from O (zero) to maximum capacity of regulator.
Safety Device Diaphragm
Gas Inlet.
Regulator diaphragm
SAFETY DEVICE to prevent bursting of the diaphragm or regulator, and injury to the operator—permanently adjusted at the factory at about 20% lower pressure than the regulator. If for any reason an excess gas pressure reaches the regulator body, the seat in the safety device opens and expels the gas through ports "B."
Gas outlet.

Insures Safety to the Operator —Prevents Accidents

Because of the nature of oxy-acetylene welding and cutting, it is of the utmost importance that the apparatus used be properly designed and made, to insure the safety of the operator. This Special Diaphragm Safety Device makes accidents impossible. You will understand the operation of it by referring to illustration and marginal notes at the left.

We have constantly had in mind the safety of the operator while designing all B-B-B Welding and Cutting Apparatus — regulators, torches and all accessories.

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No. 510. Fitted with Smoke Green Lenses.
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No. 511. Fitted with "Essentialite" Lenses. $1.50 per pair.

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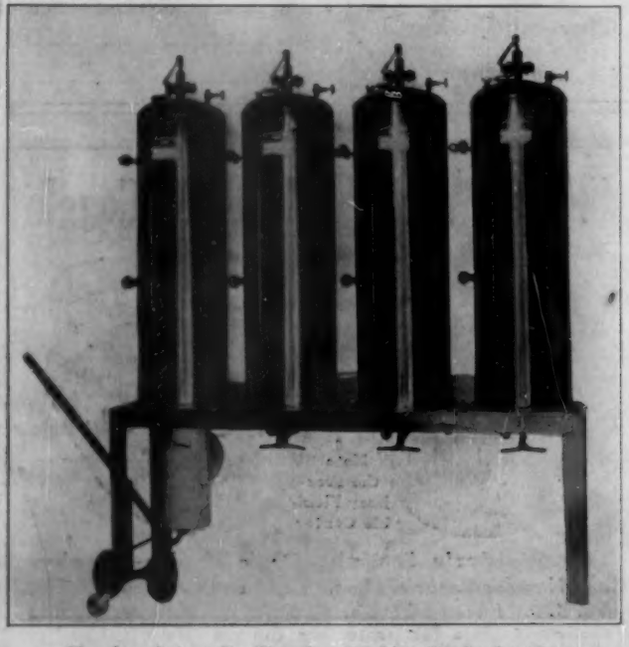
the water in the upper part of the generator. The low temperature causes the impurities to drain back into the chamber, from which they are easily removed. The layers of carbide and oily sawdust are so proportioned as to cause only the vaporization of the lighter oils such as benzine, naphthalene, kerosene and the like. The temperature is not high enough to vaporize the tar oils, as these are heavy and give a deposit of lamp-black. These heavy oils are therefore not utilized, but remain in the cartridge. The temperature in the cartridge is maintained at between 200 and 300 degrees C. (390 to 570 degrees F.) depending on the rapidity with which the gas is used and the amount which is generated and delivered. It is not intended that an actual boiling take place at any time, for if the temperature is too high there will be a vaporization of the heavy oils causing deposits in the pipes and also an increase in the impurities. The gases passing through the pipes cooled by the water of the generator are kept between 60 and 70 degrees F. In the passage through the cooled pipes the impurities are removed in the following manner: Acetylene has a comparatively high specific heat, so that its rate of cooling when passing through the pipes is low. The specific heat of the oil-gas is, however, only one-eighth of that of acetylene, hence it cools eight times as quickly. Now if the two gases are passed together along a cooling surface the temperature of the low specific heat gas will decrease rapidly and cause a rapid lowering of the temperature of the other gas. So this action results in the deposit of sulphur, phosphorus and silicon compounds and of the ammonia. In order, however, to bring about this precipitation



Showing Automatic Charging Machine Ready for Use

the temperature must be sufficiently low—that is, as stated above, between 60 and 70 degrees. If the gas finally issuing from the pipes and water was too hot the impurities would not be thrown out.

In this process the acteylene and oil-gas, generated and cooled, will combine in the pipes after the impurities are removed. It is important, however, that the impurities be removed and the product sufficiently cooled, since no real combination will take place at too high a temperature. For instance, if the water is above 180 degres F. the oil burns and no proper combination results.

The combined gas produced named thermalene possesses marked characteristics that distinguish it from oil-gas, from acetylene, and from the usual mixture of the two. The density is higher than air, being 1.1, taking air as a unity. The issuing gas can be seen to sink when thrown through a sunbeam. The specific heat is low, being a little over one-eighth of that of acetylene. Thermalene liquefies at between 1,400 and 1,500 lb. pressure and in its liquid state is non-explosive and stable. A very noticeable thing is the odor, which is not at all like acetylene, or of oil-gas, but is a soft sweet smell, not strong or offensive in any way. The color is white but with a predominating propor-

Exhibit at American Gas Institute, Chicago

tion of the red and yellow of the spectrum. The maximum flame temperature has been found to be about 6,500 degrees F. The high density of the gas has a number of advantages. It has more body than acetylene and does not need so much oxygen. It does not explode so readily as acetylene so can be mixed with greater proportions of air. In a bunsen burner it is possible to mix as much as 32 per cent of air without causing a flareback, and it can be used with a Welsbach mantle to advantage. The upper and lower explosive limits are 12 and 30 per cent. Less gas is required for a given flame than with acetylene for the reason that the gas is denser and richer, resulting in higher efficiency.

When used for welding and cutting thermalene has numerous good points. It does not require an excess of oxygen, and for this reason does not absorb carbon from the iron. The flames, therefore, produce a soft weld, especially in cast iron. When welding it is noticeable that less sparks are thrown off than when using acetylene. It can be used at a lower pressure also, owing to its higher specific gravity and greater calorific value. Owing to the removal of the various impurities there are no corrosive effects on fittings nor poisonous effects. Neither does the spent cartridge give off explosive gases for the reason that the gases liable to cause explosion are separated and drained off from the generator chamber. Corrosion of the interior walls, due to water action, is prevented by the oil-vapor which is always present and forms a protecting and sealing effect throughout. Safety lies in the feature that the pressure in thermalene apparatus never exceeds the atmospheric pressure of 15 lb.

A corner of Mr. Wolf's laboratory is shown in Fig. 5. Here A is a small sized generator and B is an oxygen tank. On the extreme right is a houselighting outfit supplying several kinds of burners. At C is a regular inverted light, 60 candlepower, estimated to cost 0.7 to operate. At D is a blow torch and at E a calcium light. This is made practically the same as other lights of this character, a heating flame being thrown onto a piece of calcium which is heated

to incandescence. A gas plate with two burners is shown at F. This last gives as good a demonstration of thermalene as any of the other apparatus. The burners are the

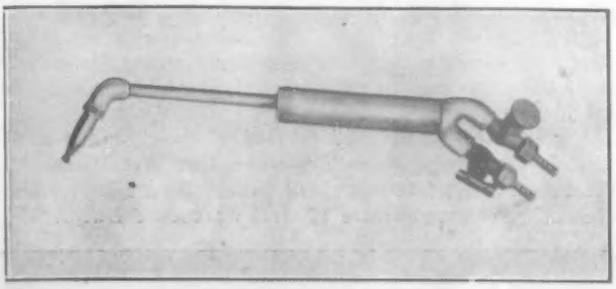


Fig. 6. Cutting and Welding Type.

usual perforated ones, and after the gas is turned on a single point of long yellow flame can be made to shoot out of one of the holes. There is no flashing around the burners of all the outlets.

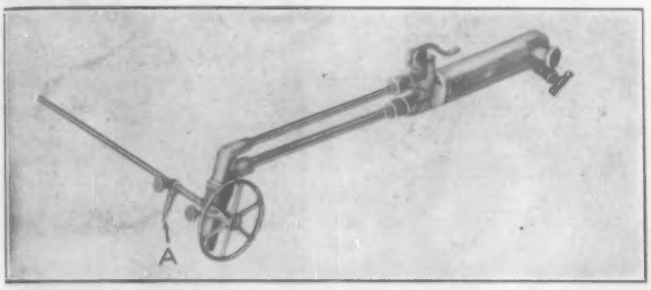


Fig. 7. Torch for Cutting Circular Pieces.

The torches were also designed by Mr. Wolf and under all sorts of tests show no tendency to flashback. One of the torches is shown in Fig. 6. This is the cutting and welding type. Another torch designed for cutting circular pieces is shown in Fig. 7. An adjustable center A is placed in a punch mark and then the torch is slowly wheeled around the circle, cutting the metal as it goes.

CLASSIFIED ADVERTISING

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FAILURES IN WELDED JOINTS

Two welded-joint failures are dealt with in a recent issue of a Swiss engineering paper. The first was in a vessel used in the manufacture of chemicals, and the second in a vertical boiler. The chemical vessel was 55 inches in diameter and about 6 feet long, with a scarf-welded longitudinal seam and the dished ends welded on. It was designed for an internal pressure of 10 atmospheres, and passed the necessary boiler inspection tests.

On the day of the explosion it was being used for the manufacture of azonbenzol. It is claimed that the contents were heated to 90 deg. Cent. when one of the dished welded ends blew out, tearing its way through a wall two feet thick, killing six workmen and seriously injuring several others. *The weld had been made by water gas or in a coke fire, and was imperfectly done, being joined only at the edges.* The weld was, moreover, in a position where it was subjected to the greatest varying strains.

The second explosion was due to the failure of a welded joint made in the central flue of a vertical boiler. The internal diameter of the firebox was 33 inches, and that of the central flue 12 inches. The boiler had been tested, and, on exploding, the arched crown sheet tore away from the flue at the circular weld. The attendant was killed. The weld was poorly made, and in a position where it had to withstand the movements of the crown sheet. *The weld was probably done by a smith, and was not of the autogenous type.*

Commenting on the explosions, the author of the reports says: "How little the character of a weld can be revealed by testing is shown by the fact that in both cases the inspectors allowed themselves to be deceived by the external appearance. A weld has something of the mysterious and uncontrollable about it that a rivet seam has not, at least in the same degree. In spite of this, there is a growing tendency toward the use of welded joints in steam vessels, especially in the chemical industry, where uniform surfaces and absence of rivet heads are especially desirable. It, therefore, behooves the owners, as well as officials, to see that the process is used without danger. In connection with tests for the Swiss Society of Steam-Boiler Owners, a large number of autogenous welds have passed through the author's hands, and the worst material was better welded and held better than the welds in the two explosions described."

In view of the tests that he has made and information in his possession, the author—who, by the way, is engineer to the above-mentioned society—proposes an efficiency of 60 per cent. and a factor of safety of 4¼. This is particularly for autogenous welding. Another method of insuring greater safety, he says, would be to carry the hydraulic test to a higher pressure.

The purchasers of boilers and steam-vessels would do well to deal only with firms having a reputation for good work. This is specially true of welded work. A welded boiler must be regarded not as a piece of ordinary market ware, to be bought by competition, but as a structure calling for especially skillful and thorough handwork.—Acetylene Lighting and Welding Journal (England).

A good example of the increased efficiency and generally decreased cost of manufacture effected by acetylene welding sheet-steel articles as compared with drilling and riveting is shown in the manufacture of steel warehouse trucks.

International Acetylene Association Holds Big "Beefsteak" Dinner on Occasion of the Regular Annual Meeting in New York

The trucks made by the Standard Improved Truck Company were formerly made by drilling and riveting all joints. Oxy-acetylene welding was proposed, and a test truck was made by this method. Results of the tests made to determine the relative strength of welded joints compared with riveted joints were so conclusively in favor of the welded joints that the welding process was immediately adopted.

Welding has not only produced a truck of greatly increased strength and rigidity, but has increased the output per man about 20 per cent, with a saving of more than 30 per cent over the previous cost of manufacture.—Acetylene Welding & Lighting Journal (England).

CREEPING REGULATORS.

A regulator "creeps" when the seat does not close against the inlet nozzle, allowing the gas from the cylinder to enter the body of the regulator beyond the pressure desired. A creeping regulator is detected by the low pressure gauge, the one over the body of the regulator, the dial of which is calibrated in pounds up to fifty or seventy-five. With the valves on the torch closed, the hand on the dial does not remain stationary, but indicates a higher pressure than it did while operating the torch. A creep of a few pounds is allowable, but when it is ten, fifteen or twenty pounds beyond the operating pressure, the use of the regulator becomes a menace, since the pressure may become great enough in the body of the regulator to burst the diaphragm or the gauge with considerable force.

Any correctly adjusted neutral oxy-acetylene flame gives a temperature of approximately 6,300 degrees F., no matter what size tip is used. Larger tips will produce a greater volume of heat, though not a greater degree of heat.

Efficiency in Pre-Heating

Every first-class welding shop should include in its equipment a good oil-burning pre-heating torch.

Charcoal is essential for some purposes, but this torch is so much faster and cheaper as to make it an absolute necessity in the welding shops.

Type No. 1-B, Vulcan

which is illustrated, is especially adapted for brazing and pre-heating for welding. This torch has a capacity of 6 quarts of kerosene and will operate 1 hour on one gallon. It gives a clear, blue flame, 24 inches long. **The torch may be used in any position.**

It is economical, gives intense heat and throws off no smoke at all. The oil is practically gassed before burning—that's why it's so efficient.

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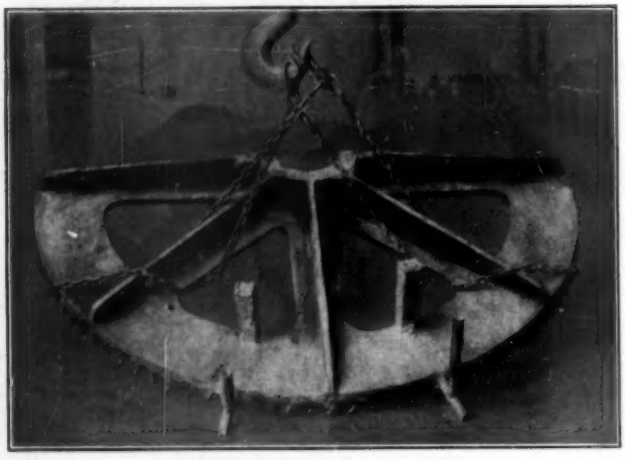
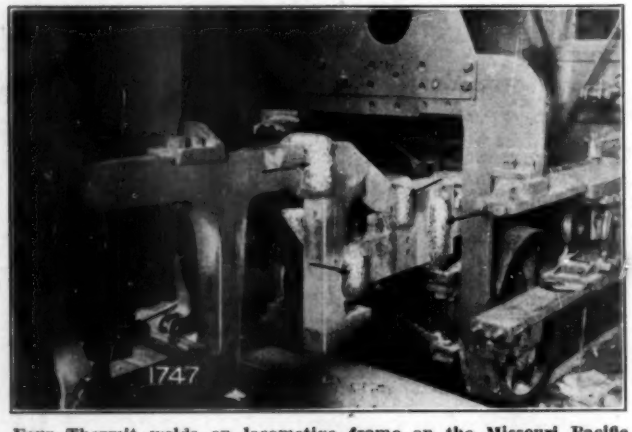
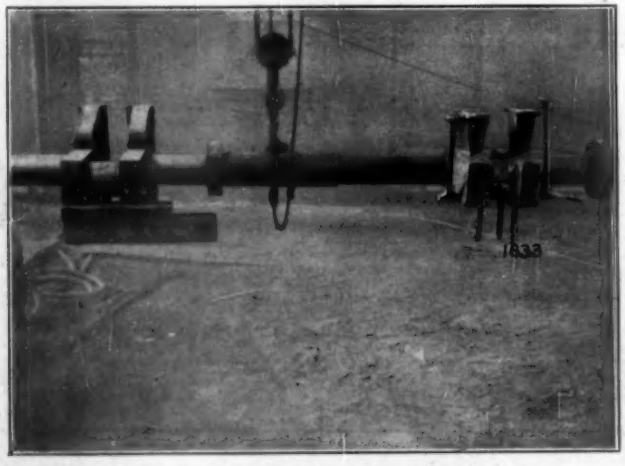
New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.



Large bevel gear on which two new teeth and crack have been repaired.



Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.



New crank pin welded in by the Thermit Process.

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